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DIGITAL TRANSFORMATION OF LOGISTICS CENTRES: BIBLIOMETRIC ANALYSIS

Abstract

With the rise of the digital economy, a new sort of logistics, known as e-logistics, has emerged as a "must-have" in the worldwide logistics business. That is why this topic becomes so relevant among scholars and the industrial field. The idea of the research is based on the analysis of the literature on transformation of logistics centres. The goal of this study is to quantitative assessment of the current literature on the topic of digital logistics centres by identifying the most relevant areas and a gap in the literature. The research methodology is based on bibliometric analysis using the articles in the Scopus database. Generally, 127 scientific papers from 2019–2023 were analyzed through VOSviewer. Research results show that after the Covid-19 pandemic a large number of technological digital solutions emerged and the pandemic served as a spur to the active use of digital technology by various organizations. The most productive countries were the United Kingdom, the United States, China, Germany and Italy. The study evaluated the following parameters: top publishing countries, most cited authors, widely studied fields, research clusters, etc. The results of the study showed that the most studied areas are digital transformation, Industry 4.0 and supply chain management, while the digital transformation of logistics centers and the application of practical tools have not yet been fully explored. The findings and propositions of the study can contribute to the digital development of local logistics centers and expand the literature in this area.

Key words: logistics, logistics centers, digital transformation, bibliometric analysis, statistics.

Introduction

Today, logistics processes are one of the key sectors in the development of a country's economic performance. Due to global changes in economic trends as well as the current geopolitical state of the world, the focus on changing the structure of logistics chains and routes is more relevant than ever. During the last decades, there have been significant transformations in organizational forms, tools, and technologies for managing logistics of companies and supply chains due to the development of the paradigm of business digitalization [1]. The digitization of internal logistics processes at the warehouse and distribution centre level is an innovative solution, both in terms of optimizing human capital and increasing order fulfilment. Customer expectations regarding the speed of order fulfilment are increasing with the spread of home delivery via e-commerce or omnichannel operations. Stringent demands for speed, such as delivery within an hour, require physical availability of stock close to the

point of demand. This necessitates a wide and dense network of stocks and a sound stock location model [2].

Digital economy conditions lead to the search for new forms and methods of supply chain organization and logistics management [3]. An equally important and promising area for improving logistics activities is undoubtedly the digitalization of certain processes within supply chains. The digitalization of the transport system and the automation of logistics processes provides an opportunity for a country's economy to move towards global trade and industry networks. This is an interesting topic to explore and has been covered in a number of academic fields. A review of the literature has shown that ICT in the logistics industry has a significant impact on economic development [4]. The automation and digitalization of logistics processes of different nature concerns both fullfilment centres and classic logistics warehouses and distribution centres. However, the context of the relationship between logistics performance and ICT and the economy still needs to be explored. An exploratory review of previous works in this field may make a huge contribution to the development of digital logistics concept in terms of science and business area.

This study considers a bibliometric analysis in terms of identifying trends and statistical data on the extent to which the topic of logistics centres digitalization has been studied by other authors. On the basis of the data obtained, it will be possible to judge the comprehensiveness of the topic and the coverage in terms of publications by year, journals, authors, affiliations, countries, sponsoring organizations and keywords. The study defines digital transformation in the context of logistics centres as the object of the research. The subject is the methods of bibliometric analysis performed. The aim of the research article is to identify the trends and the extent to which logistics digitalization has been studied on the basis of the literature of previous researchers. In accordance with the goal, the next objectives were defined:
- To identify the top trends and the most explored fields on the studied topic in quantitative terms;
- to carry out a literature review of the authors' previous bibliometric studies on the topic;
- to identify the approaches for future research in this field.

The practical relevance and results of the bibliometric study will be qualitatively useful in developing new proposals for the study of the digital transformation of logistics centres.

Materials and methods

The method of the study is quantitative data collection. A bibliometric analysis on previously generated literature by other authors in the context of previous studies was applied, namely the statistical research method, the method of counting the number of previous publications. The general scientific methods of this article are analysis and synthesis, the method of deduction.

Research design is shown below in the Table 1.

Table 1 – Research Design

Stage 1 Search Criteria Keywords: Logistics OR Supply Chain Management AND Digital Transformation	Stage 2 Scopus database	Stage 3 Research Refinement Scopus: 127 papers Year: 2019–2023

Stage 4 Export of final data	Stage 5 Analysis and discussion
Note: Designed by the authors.	

Data source from the Scopus database have been analyzed. Research sample is based on the work of various academics who have considered the current state-of-the-art and modern technologies in the context of the digital transformation of logistics centres.

The tools: statistical tables, graphs and charts have been generated based on the monitoring of previous studies regarding the digitalization of logistics centres from Scopus data. In the process of systematizing the results of the study, the method of comparison was used. VOSviewer software was used to visualise and identify the most used words of the research topic in the works of other authors.

Main provisions

The Kazakhstani logistics and supply market is attractive in terms of financial investment in the industry. A major foreign operator is expected to enter the Kazakhstani market with its own logistics companies, with a modified quality of service and an innovative model of supply chain management, which has not previously been introduced in Kazakhstan. Taking into account all the positive and negative aspects of the arrival of a major operator, one thing can be said with certainty, it is the arrival of improved technology and world-class operating principles, which will further accelerate the development of not only the logistics services and supply market, but also business and the economy as a whole [5].

According to the reference to the authors in the previous paragraph, it is advisable to highlight the fact that there is an increasing trend in the world for the effect of digital technologies on the improvement of the logistics sector, and that innovative technologies are being actively implemented in logistics and infrastructure operations. Data monitoring in Kazakhstan has shown that the digital transformation of the logistics services industry is still in its infancy. Therefore, it is rather problematic to assess the impact of innovative technologies on the improvement of transport and logistics and fulfilment in the country, as outlined on the basis of an analysis of the scientific literature. Transport and warehousing companies are not investing sufficient financial resources in digitalisation. There is a need to develop mutually beneficial mechanisms for the government and the private sector to implement digital technologies in the transport and logistics industry in the country. The introduction of electronic document management in freight and transport processes, transparency in supply chains, automation of loading and unloading operations in warehouses, transport and logistics centres and terminals, and other ways of digitalization are extremely important [6].

The extent to which the digital transformation of the logistics sector has been studied on the basis of previous studies by various authors indexed in the Scopus database is subject to bibliometric analysis. The main trends will be identified and conclusions will be drawn on the completeness of the research on this topic.

Literature review

If we look at the topic of digital transformation of logistics centres through the prism of previous studies by a number of authors based on their bibliometric analysis, it can be noted that such studies have been carried out more in the field of innovative and emerging digital technologies applicable directly to logistics centres. The digital transformation in any case envisages the transition of classical logistics processes to automated and digital ones based on the application of cloud services, the robotization of certain logistics units and processes, etc.

The bibliometric analysis conducted by Kaple was highlighted the trends in E-Logistics between the year 1981 to 2022 (till 26/5/2022) through the sample of 402 studies from the Scopus database was analyzed using the VOS viewer tool to distinguish research activity on E-logistics. The citations, publications, location, and network events are used to trace out the most prominent articles and authors. The highest number of publications is observed in 2021, with a total of 59 documents (14.67%) [7]. But this study didn't consider the topic of digital technologies used in logistic centers.

Further Kostetskyi P. carried out a rather extensive study on the topic of studying the digitalization of logistics processes in the enterprise and their transparency [8]. His bibliometric analysis illustrates that there is a close relationship between process transparency and digitalization.

The bibliometric article by Pan S., Trentesaux D., McFarlane D., Montreuil B., Ballot E., Q. Huang G. proposes a number of research directions to improve experiments and various applications in logistics and retailing, and to achieve interconnection in logistics and supply networks in order to strive for a certain sustainable result [9].

In Agostino Í.R.S's., Broda E's., Frazzon E. M's., Freitag M's. book, on the basis of bibliometric analysis, a digital twin approach was presented for production planning and management, using current data on the state of cyber-physical systems in real time format. The approach was evaluated using a real-world scenario involving a manufacturer supplying mechanical parts to the automotive industry [10].

The study by Argumedo-García M., Salas-Navarro K., Acevedo-Chedid J., Ospina-Mateus H. presents a bibliometric analysis of research on potential technologies in the humanitarian supply chain. The methodology illustrates performance analysis and scientific mapping to explore the application of digital technologies in humanitarian supply chains. This paper makes a substantial contribution to the literature, based on bibliometric data on the most influential authors, trends, journals, countries, research bases and recent collaborations in the field of humanitarian supply chains [11].

Zhidebekkyzy A. and Moldabekova A. stated that bibliometric network analysis was performed to highlight research areas to explore innovative technologies in logistics services. The article highlights the classification of information and communication technologies in logistics service industry, new trends in logistics service in terms of Industry 4.0 and the impact of modern technologies on logistics service quality management [12].

According to a study by Kabakuş A., Ayaz A. digital transformation, which prioritizes human intelligence and includes many technologies such as Internet of Things, cloud computing, blockchain, Big Data and artificial intelligence, brings significant changes in business processes and social life [13].

The results of the Kruljac Ž's. study prove the inconsistency between the definition and the digital economy context itself, as well as the significant impact of the small number of authors and journals in the study area [14].

The study by Çiğdem Ş. was expected to contribute to the relevant literature in terms of understanding how technological change is shaping supply chains [15].

According to a study by author Burak M., the majority of publications in the field of e-logistics were published in 2004, the language of publications was mainly English, the country with the highest number of publications was China [16].

The authors Atzeni G., Vignali G., Tebaldi L., Bottani E. present the results of bibliometric analysis of 64 scientific papers devoted to the topic of collaborative robots in logistics [17].

The author Katoch R. in his study offers numerous insights into significant aspects of IoT in SCM and logistics by applying bibliometric analysis. A brief account of key IoT technologies and their role in a variety of SCM operations is presented [18].

An article by Fang H., Fang F., Hu Q., Wan Y. defines supply chain management based on a review of existing literature and discusses the current state of research in supply chain management as well as promising future work in this area [19].

Muñoz-Villamizar A., Charris E., Quintero-Araujo C., Santos J. analyze supply chain management research in sustainability and digitalisation using a bibliometric approach. For this purpose, the article analyzes 484 articles from the Scopus database according to the following parameters: chronology, discipline, source, research centre, country and citation index [20].

The aim of the study of the authors Bigliardi B., Casella G., Bottani E. – to contribute to the state of the art on Industry 4.0 by analyzing and reviewing the scientific literature, with reference to the field of logistics [21].

The authors Hasler D., Schallmo D. identified the main areas of research in the field of digital logistics platforms and grouped them by analyzing the collaborative citation network [22].

As observed by Kaple, several problems which arise in corporate logistics include delayed and inaccurate information, incomplete services, slow and inefficient operations, and high product damage rates [7]. This emphasizes the need of reliable data exchange among various parties involved in the logistics value chain. He critically examined the importance of using digital tools like information technologies for the optimization of supply chain system in an organization. Under such circumstances, the role of information technologies including the Internet, World Wide Web (WWW), and Electronic Data Interchange (EDI) in providing shared-information platforms for improving logistics performance is significant [23].

Results and discussion

The international bibliographic database Scopus has been identified as a field of study in order to identify the main trends in the degree of research on the digital transformation on the basis of logistics centres. During the work with this database, we found that in the process of searching for relevant information in the field of logistics and digital transformation, the fields of study were completely varied. For example, in the field of Computer Science knowledge, there were 45 suggested materials to study. Having monitored the data in this discipline, we observed that most of the articles offered a

detailed study of digital technologies, but they mostly did not reflect their relevance to the logistics industry and logistics centres. In terms of keyword searches for Digital Technologies, we found that the breadth of the disciplines was also quite large and had very little relevance to the logistics industry. The keywords Digital Transformation were ideal for searching digital processes and technologies for optimizing logistics centres.

The following keywords were applied to the search field during the final systematization of the data and the subsequent analysis based on the Scopus database: Logistics OR Supply Chain Management AND Digital Transformation. The coverage of the historical years of publication is from 2019 to 2023. The knowledge industry has been restricted to Business, Management and Accounting, Decision Sciences, Economics, Econometrics and Finance and Engineering. The total number of publications is 127.
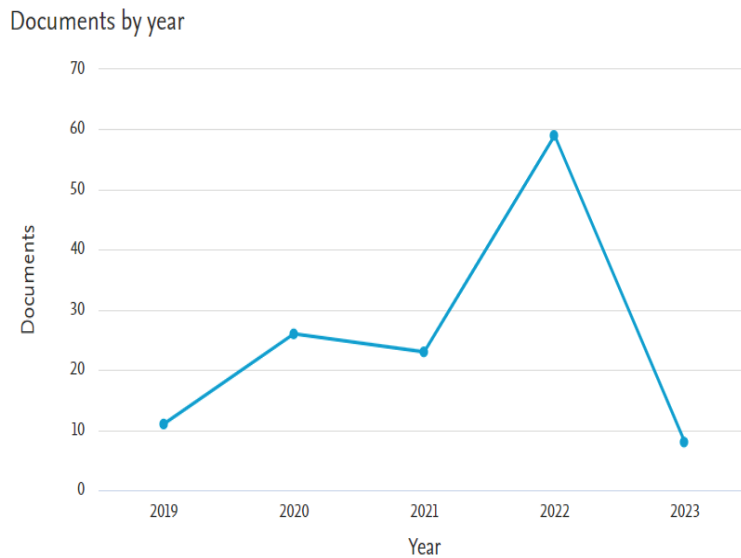
Figure 1 – Statistics of publication of authors' papers by year

Note: Compiled from the source https://www.scopus.com/

If we analyze the data from Figure 1, we note the fact that the most active surge of publications on this topic came in 2022 with 60 studies. This can be attributed to the fact that a large number of technological digital solutions emerged after the Covid-19 pandemic. As of 2023, the number of publications is strikingly lower at 10, but it is only right to monitor trend updates for 2023 in 2024 in order to compare the data correctly.
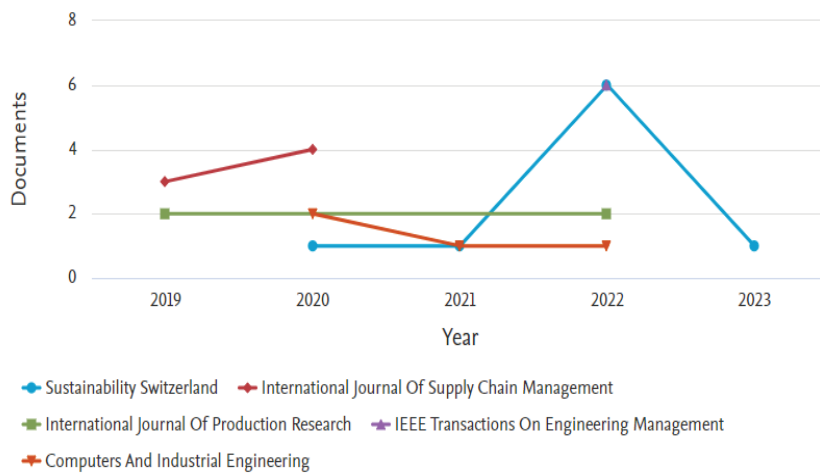
Figure 2 – Authors' paper publication statistics by journal by year

Note: Compiled from the source https://www.scopus.com/

According to the statistics in Figure 2, it can be concluded that Sustainability Switzerland was the most popular journal for publications on the topic of digital transformation in the logistics industry. This journal peaked in 2022 with 6 publications. The International Journal Of Supply Chain Management showed a significant decline and has not published since 2020. The sample was based on the top 5 journals.

Figure 3 shows that the most actively published author between 2019 and 2023 is Cherrafi, with 4 publications.
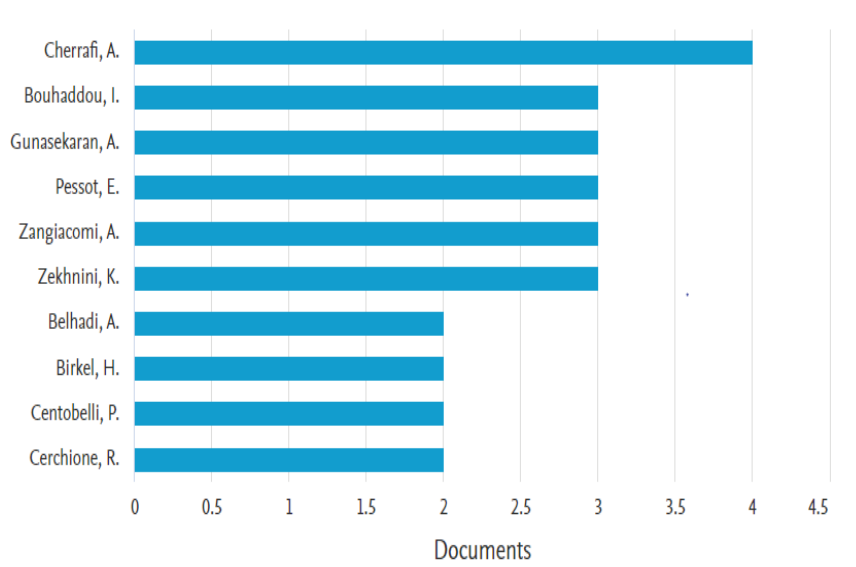
Figure 3 – Document publication statistics by author

Note: Compiled from the source https://www.scopus.com/

As Figure 3 shows Bouhaddou, Gunasekaran, Pessot, Zangiacomi, Zekhini who published an equal number of articles – 3. Researchers Belhadi, Birkel, Centobelli and Cerchione each published 2 papers.

The Figure 4 shows the affiliations of the authors of the publications.

Within each of the research bases presented, 3 articles were published. The coverage is the top 10 affiliations.

Figure 4 – Authors' document publication statistics by affiliation

Note: Compiled from the source https://www.scopus.com/

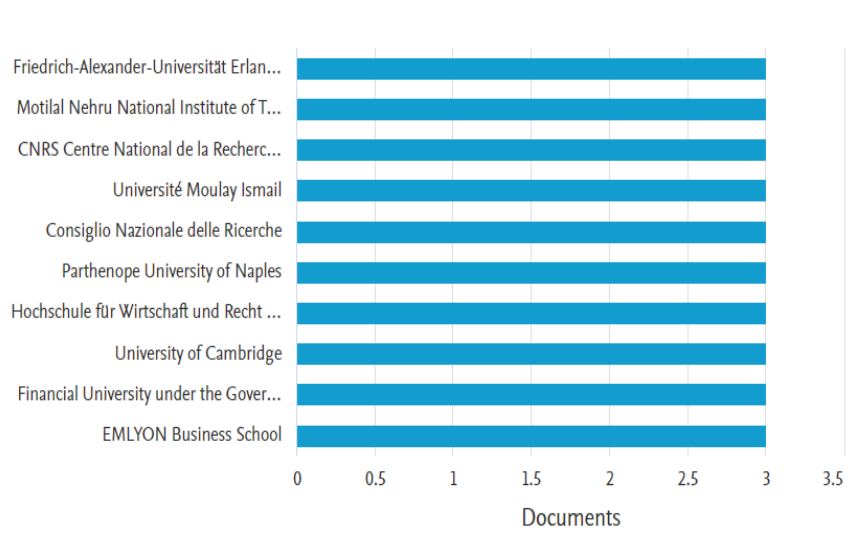Further the Figure 5 shows a sample of the top 15 most actively published authors by country on the topic of digital transformation in logistics.
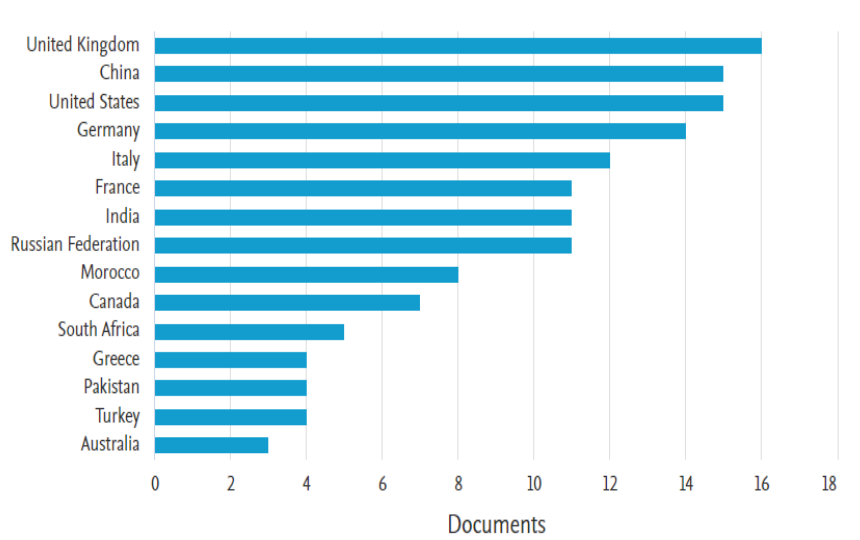

Figure 5 – Publishing statistics of authors' papers by country

Note: Compiled from the source https://www.scopus.com/

As depicted in Figure 5, the most actively published country is the UK, with academics from the UK publishing 16 articles between 2019 and 2023. Researchers from Australia have the lowest number of publications compared to the other countries in the statistics presented, with 3 publications in 4 years. In any case, with the near-total removal of Covid-19-related restrictions around the world, the number of studies and inventions in digital technology will only increase as logistical processes move to a new level year after year.

Further the Figure 6 presents the statistics papers by sponsoring organizations.

Figure 6 – Publication statistics of authors' papers by sponsoring organization

Note: Compiled from the source https://www.scopus.com/

It is reasonable to conclude from Figure 6 that the European Commission and the National Natural Science Foundation are the most interested organizations in sponsoring authors' publications in the

field of digital transformation of logistics processes in the context of logistics centres. All top 10 sponsoring sources are European organizations. The sponsorship by leading organizations of scientists in project activities for the purpose of subsequent research articles is a key indicator of the interest of public institutions in achieving new results and discoveries in any field of scientific activity.

A cluster analysis by using VOSviewer helps to reveal the most explored and relevant directions on this topic.

Figure 7 – The most popular words based on analysis from the Scopus database

Note: Compiled by the authors on the basis of VOSviewer.

According to the data generated from Figure 7, it can be noted that the most frequent and overlapping words are digital transformation, industry 4.0 and supply chain management. It is noteworthy that digital technology is directly related to logistics activities. There is a total of 72 words that make up this structure. The study can distinguish 4 key clusters from this visualization:

1. The supply chain management cluster includes such frequently crossed keywords as digital technologies, internet of things, big data;

2. The digital transformation cluster includes the most frequent word supply chain and others;

3. The industry 4.0 cluster most often refers to cyber-physical systems;

4. The covid-19 cluster is certainly related to certain kinds of barriers that emerged in the economy during the lockdown period. But it is precisely during this period of total constraint that innovative ways of logistical innovation have emerged.

All the words on the map overlap in one way or another, but in one way or another, they all boil down to the main focus of this study: the digital transformation of logistics centres.

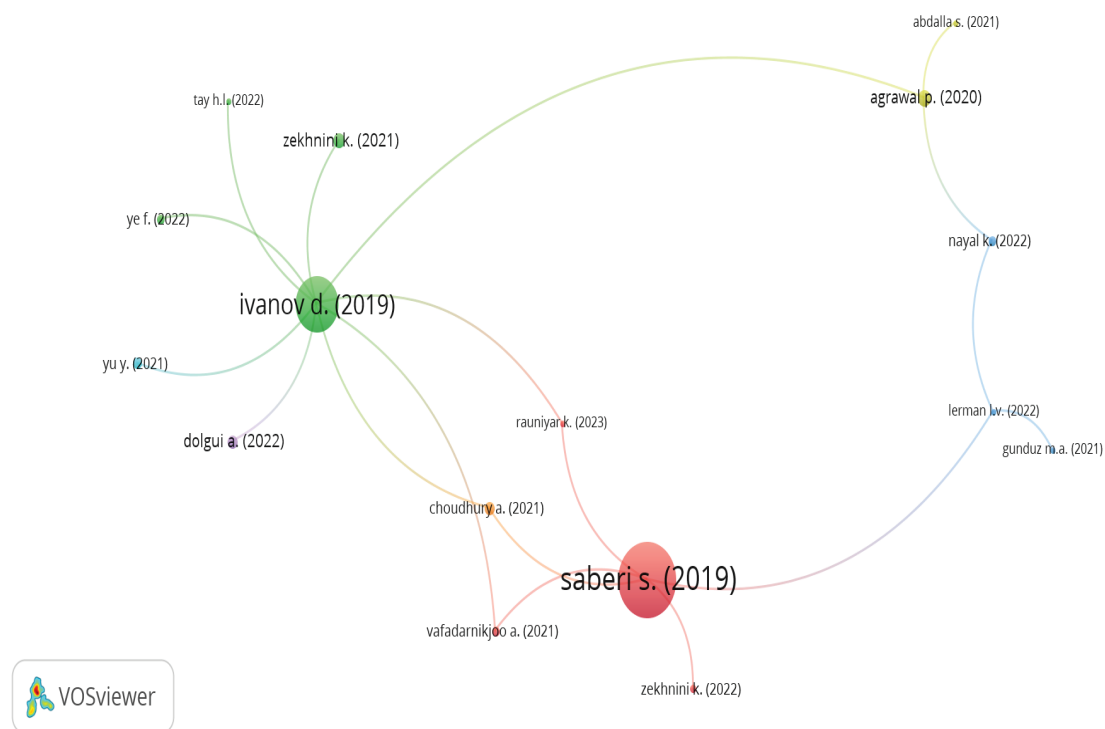The next figure represents the most cited authors (Figure 8, p. 275).

Figure 8 – The most cited authors based on analysis from the Scopus database

Note: Compiled by the authors based on VOSviewer.

As can be seen from Figure 8, the most cited authors, who have investigated the topic of digitization of logistics processes based on logistics centres, are Saberi and Ivanov. The other authors in most cases referred to these authors when writing and publishing their papers.

Based on the data obtained and analyzed, it can be concluded that the trend in the study of the digital transformation of logistics centres has varied depending on years, countries and other indicators.

Considering the bibliometric analysis done in this study and its methods, it can be argued that the degree of research and the diversity of the literature represented in the Scopus database differ from country to country. It may be due to the different maturity levels of the logistics infrastructure and technological development of the region.

Conclusion

Research findings revealed that the topic of digital transformation of logistics centres are well explored in the countries like UK, USA, China, Germany and Italy due to the high potential of global supply chain and increased digital infrastructure. As research results show, there were derived the following four major clusters in literature: supply chain management, digital transformation, industry 4.0, covid-19. The area of applying digital technologies at logistic centres, transfer of digital technologies, and methodological approach for the adaptation of digital models is still uncovered by scholars. Therefore, future research may be dedicated to these topics. Research limitations are connected with the restriction like using just one database. Thus, future research of scholars and scientists may cover additional platforms: Web of Science, Google Scholar, MatfSciMet and others.

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ЛОГИСТИКАЛЫҚ ОРТАЛЫҚТАРДЫҢ ЦИФРЛЫҚ ТРАНСФОРМАЦИЯСЫ: БИБЛИОМЕТРИЯЛЫҚ ТАЛДАУ

Аңдатпа

Цифрлық экономиканың өсуімен электрондық логистика деп аталатын логистиканың жаңа түрі дүние-жүзілік логистикалық бизнесте міндетті тетік ретінде пайда болды. Сондықтан бұл тақырып бүкіл әлемдегі ғалымдар мен бизнес ортасының өкілдері арасында өзекті болып отыр. Зерттеу идеясы логистикалық орталықтарды трансформациялау бойынша әдебиеттерді талдауға негізделген. Бұл зерттеудің мақсаты-әдебиеттегі ең өзекті бағыттар мен олқылықтарды анықтау арқылы цифрлық логистикалық орталықтар тақырыбындағы заманауи әдебиеттерді сандық бағалау. Зерттеу әдістемесі Scopus деректер базасындағы мақалаларды пайдалана отырып, библиометриялық талдауға негізделген. Жалпы, VOSviewer бағдарламасы арқылы 2019–2023 жж. аралығындағы 127 ғылыми жұмыс талданды. Зерттеу нәтижелері көрсеткендей, Covid-19 пандемиясынан кейін көптеген технологиялық цифрлық шешімдер пайда болды және пандемия әртүрлі ұйымдардың цифрлық технологияларды белсенді қолдануына түрткі болды. Ең өнімді елдер Ұлыбритания, АҚШ, Қытай, Германия және Италия болды. Зерттеу барысында келесі өлшемдер бағаланды: үздік баспагер елдер, келтірілген дәйексөз саны ең көп авторлар, кеңінен зерттелген салалар, зерттеу кластерлері және т.б. Зерттеу нәтижелері ең көп зерттелетін салалар цифрлық трансформация, индустрия 4.0 және жеткізу тізбегін басқару болса, логистикалық орталықтардың цифрлық трансформациясы және практикалық құралдарды қолдану әлі де толық зерттелмегенін көрсетті. Зерттеу нәтижелері мен қорытындылары жергілікті логистикалық орталықтардың цифрлық дамуына ықпал етіп, осы саладағы әдебиеттерді кеңейтуге үлесін қоса алады.

Тірек сөздер: логистика, логистикалық орталықтар, цифрлық трансформация, библиометриялық талдау, статистика.

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ЦИФРОВАЯ ТРАНСФОРМАЦИЯ ЛОГИСТИЧЕСКИХ ЦЕНТРОВ: БИБЛИОМЕТРИЧЕСКИЙ АНАЛИЗ

Аннотация

С ростом цифровой экономики новый вид логистики, известный как электронная логистика, стал обязательным в мировом логистическом бизнесе. Именно поэтому эта тема становится настолько актуальной среди ученых и представителей бизнес-среды во всем мире. Идея данного исследования основана на анализе научной литературы по трансформации логистических центров. Целью данного исследования является количественная оценка современной литературы по теме цифровых логистических центров путем выявления наиболее актуальных направлений и пробелов в литературе. Методология данного исследования основана на библиометрическом анализе с использованием статей из базы данных Scopus. Всего через программу VOSviewer было проанализировано 127 научных работ за 2019–2023 гг. Результаты исследований показывают, что после пандемии Covid-19 появилось большое количество технологических цифровых решений и пандемия послужила толчком для активного применения цифровых технологий различными организациями. Наиболее производительными странами были Великобритания, США, Китай, Германия и Италия. В ходе исследования были оценены следующие параметры: лучшие страны-издатели, наиболее цитируемые авторы, широко изученные области, исследовательские кластеры и т.д. Результаты исследования показали, что наиболее изученными областями являются цифровая трансформация, индустрия 4.0 и управление цепочками поставок, в то время как цифровая трансформация логистических центров и применение практических инструментов до сих пор не изучены в полной мере. Выводы и положения исследования могут способствовать цифровому развитию местных логистических центров и расширению литературы в этой области.

Ключевые слова: логистика, логистические центры, цифровая трансформация, библиометрический анализ, статистика.