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Review

Shared Logistics—Literature Review

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Abstract: In the face of the energy crisis and the ever-increasing earth's temperature, one of the ways to deal with these two challenges is to make better use of the existing resources, decoupling, and the circular economy. The solution for the full use of resources is in sharing them, and also in logistics. We decided to review the existing research and concepts in the area of shared logistics to summarize where science is on this subject, what is already known, what is missing, and what is worth supplementing. This paper summarizes the scientific achievements in shared logistics in the 2017–2021 period. Our goal was to create a literature review that would serve as a benchmark for future researchers about what has been achieved and what has not been achieved on the topic, which approaches have already been tried, and what the results have been. For readers other than researchers, our review will provide an important context about where science and practice are in the area of shared logistics. Desk analysis, visual analysis, and benchmark datasets of approaches have been reviewed and discussed to show possible aspects of shared logistics and the advantages it offers to supply chains across many industries. Our analysis showed that the most commonly discussed topics in the area of shared logistics are modeling the potential of sharing in logistics, and digitalization of processes. The last popular topic among researchers is fleet sharing and shared packaging, as well as barriers to implementation and data security. Our paper is a summary of current knowledge on shared logistics, and it highlights areas that require further research.

Keywords: shared logistics; sharing logistics; literature review; vehicle load factor; joint distribution; cooperation among companies; peer-to-peer networking practices; non-standardized logistics processes

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1. Introduction

Logistics processes are becoming increasingly complex, with a growing number of cooperating parties, a variety of logistics assets, and infrastructure objects involved. The scope of services becomes wider and more specialized, and equipment and IT tools are more widely available. As a result of the complexity, sharing economy rules apply and create a scope of new possibilities, generally referred to as shared logistics. This refers to the general idea of sharing assets and services between various end users rather than owning or producing them. The general goal of shared logistics is to achieve better results and higher efficiency of logistics processes than it is possible to achieve when acting individually. The idea of shared logistics is derived from the basic function of supply chain management, which is a partnership for achieving goals. The relations that are formulated between entities over time may then lead to closer bond collaboration. Collaboration between supply chain members requires the availability of integrated information and a high level of motivation as well as trust [1].

The concept of sharing may be translated into various types of transactions, such as co-development, hiring, or cost sharing. As a result, definitions of shared logistics may vary, depending on the characteristics of the business processes taken into account. A few hundred research papers related to the topic of shared logistics have been published so far, which underline both the academic and practical relevance of the topic, but also describe

the diversity and complexity of logistics processes based on the idea of sharing. In this review, we structure and review the literature on shared logistics.

Logistics operations are transforming on many fronts, including the incorporation of information technology into logistics operations, process automation, standardization of labeling, addressing, and packaging, as well as joint logistics operations. These processes require certain investments in research and development, as well as in IT tools, machines, vehicles, and other logistics infrastructure. Moreover, they also require expert knowledge and a qualified workforce. These elements can be subject to the process of sharing, either as single elements or holistic business services.

At the same time, the concept of sustainable logistics and advances in research on horizontal cooperation in logistics for sustainable transport and logistics present new ideas in terms of cooperation in the business environment. Collaboration in supply chains takes place between independent organizations.

Shared logistics is an effective way to increase the efficiency of logistics operations. In the field of procurement, joint purchasing may become a way to more efficient price/quality negotiations. In the era in which we are facing the scarcity of resources, the energy crisis, and the need to move from fossil fuels to renewable energy sources, the way to use existing resources more effectively, to their total potential, is to share them. In terms of procurement, the joint use of production lines, packing lines, and production plants eliminates the need for expensive infrastructure investments. Joint distribution cannot only improve the load rate of freight vehicles and reduce logistic costs but also relieve traffic and reduce environmental pollution in the city. And finally, cooperation in the reverse logistics flows may include joint investments in recycling technologies or refurbishment plants. Therefore, shared logistics is set to eliminate high infrastructure costs, unnecessary emissions, and other issues of inefficiency in logistics processes. At the same time, it allows the development of a market strategy of technical and "know-how" development, together with increased operational flexibility as a result of access to the available shared resources. By sharing resources, companies also increase their utilization and therefore contribute to reducing energy consumption and greenhouse gas emissions [2]. Currently, in new business environments such as multi-channel retail, logistics is characterized by high frequency, fragmented flows, short delivery times, multi-channel distribution, and uncertainty. It is therefore often inefficient and unsustainable. In this context, new logistics systems need to emerge, possibly based on more efficient, responsive, sustainable, and resilient solutions resulting from the collaboration of logistics companies. Shared logistics can be defined as the process of sharing logistics functions, assets, and information to rationalize logistics work, and improve the efficiency of transport and logistics processes while reducing transport costs and environmental impact. Shared logistics refers to the concept of multiple parties sharing transportation and logistics resources to reduce costs and improve efficiency. This can include sharing shipping lanes, warehouses, and delivery vehicles, among other things. It is often used in the context of supply chain management and can include both public and private sector organizations. Companies across a supply chain may primarily share their transport and warehouse capacity. There are two main ways in which logistics companies can share transport capabilities: companies can split vehicle capacity simultaneously [for instance, by ride sharing] or over time (for example, by truck sharing). Both ride sharing and truck sharing allow the cost of the journey to be divided between sharing partners and bring significant environmental benefits [3].

The authors believe that their review will be useful for researchers in the future as it clarifies the scope of the topic and provides an overview of what is currently known and what areas need further exploration. The review is informative and organized thematically, and it highlights the growing relevance of shared logistics in contemporary supply chains. Our work shows the value and benefits of shared logistics, which is a cooperative approach to logistics operations where companies work together to increase efficiency and reduce costs. The study references several studies and papers that have modeled and examined different aspects of shared logistics, such as economic and environmental goals, social

needs, and vehicle load factors. Our review will be useful to researchers who intend to study and analyze the subject of shared logistics as the basic reference point for what has already been done in this young concept and what is missing. Our purpose was to collect the previous research and debates relevant to the subject of shared logistics and to present the achievements in one place. In addition, we believe that our paper allows the reader to gain current knowledge in this area and learn about the boundaries and limitations, and perhaps extend/expand them. The analysis also allows for a better understanding of the nature of sharing processes in logistics, as well as across industries that use shared solutions in their supply chains. The variety of sharing concepts and a broad range of processes that can be supported by them calls for a systematic analysis of the features of shared logistics. This literature review aims to answer the following questions:

1. What topics related to shared logistics are discussed?
2. In which regions of the world is this innovation particularly appreciated?
3. Is the topic treated more often as the subject of modeling or are concepts and visions of future frameworks drawn?
4. What areas of shared logistics are not sufficiently addressed in the literature?
5. What are the recommendations for future publications?

2. Methods of Analysis

The years 2017–2021 were selected for the analysis, as the concept of sharing in logistics began to appear in logistics in 2015, and more often only in 2017, therefore this year was chosen as the beginning of the analyzed period. The keywords used in the search were "shared logistics" in quotation marks. To collect the articles for this analysis, first, the Scopus database was used, which gave the result of 26 papers for the selected range. Additionally, the Google Scholar database was used, which for the analyzed period, gave 421 results for the password "shared logistics" (including the 26 that Scopus found). The reason Google Scholar was used is that it offers results of scientific papers across many disciplines and therefore allows for a wide analysis of how shared logistics is being defined and used by all sorts of businesses and organizations. After carefully examining all 421 documents, 160 documents were found to be scientific papers. All of them were read and 74 studies were selected for the final analysis as those that were significantly related to shared logistics.

We decided not to use meta-analysis as the studies analyzed were not similar enough to combine their results meaningfully; therefore, the meta-analysis may not be valid. In addition, desk analysis allowed us to can use our knowledge and expertise to interpret the literature and make connections between different studies that may not be apparent to a software tool. Desk analysis can apply critical thinking and evaluate the quality of the studies, while a tool only can classify the studies based on the given criteria. Desk analysis in this case allowed us to adapt the review to the unique characteristics of their topic and research question, while meta-analysis is limited to the parameters it has been programmed with. In addition, our desk analysis allowed us to handle nuanced information and understand the implications of the findings.

The selected papers' data were entered into Mendeley software, which is a tool for creating bibliographies and organizing research work and allows the creation of bibliographic databases. With a list of references, we were able to create a file in a format accepted by the VosViewer program. VosViewer is a software tool that allows the creation of visual bibliometric networks. The networks can contain specific journals, specific researchers, or, in our case, keywords. They are created based on biographical data. Additionally, desk analysis of the read texts was made and grouped according to the subject matter to which they relate, as part of shared logistics.

Figure 1 shows the number of articles that respond to a Google Scholar "shared logistics" query since 2015 when it started to appear in scholarly research.

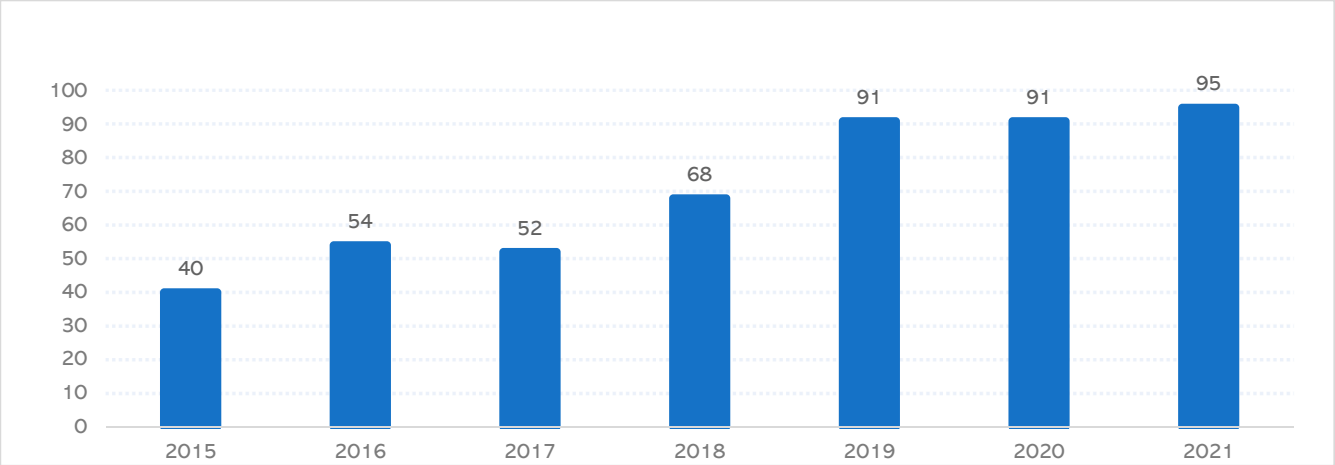

Figure 1. Number of papers mentioning shared logistics since 2015. Source: Own elaboration based on Google Scholar data.

Distinguishing geographical areas in which shared logistics processes are most often analyzed is important because it can provide insight into where the most active research community for shared logistics is located, which can be beneficial for researchers looking to collaborate or stay up-to-date on the latest developments in the field. It can give researchers an idea of the policy environment and regulations that have been established in different countries, which can be beneficial for understanding the impact of different policies on shared logistics. Finally, it can help researchers to identify the direction and trends of the field in different countries, which can be beneficial for identifying opportunities for future research and development. Scientists who appreciate the potential of shared logistics most often come from China (33) and then from the USA (7), France (6), and India (5), which may indicate that these countries are open to innovation, but it is a simplification that would require further research. Figure 2 illustrates the origin of the authors of the papers we were able to find the affiliation for.

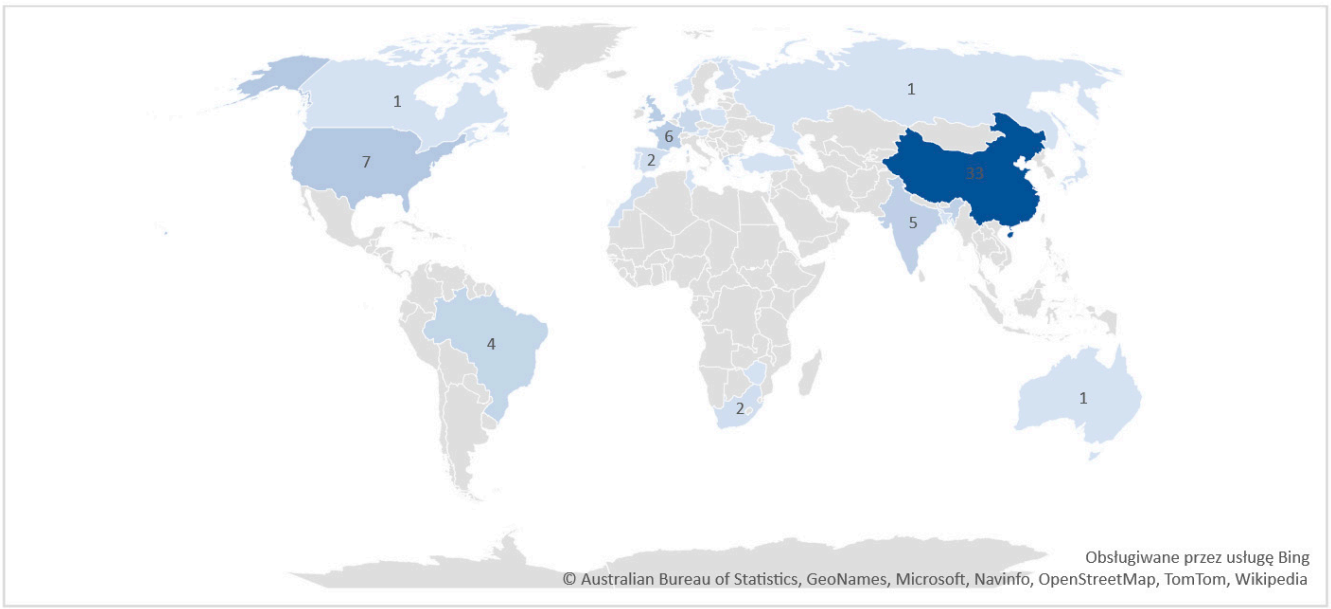

Figure 2. "Shared logistics" subject—authors' nationality. Source: Own work.

China has a rapidly growing economy and is a major player in the global supply chain, particularly in manufacturing. As such, it has a vested interest in exploring ways to improve

logistics and supply chain efficiency, which could include shared logistics. Furthermore, the country has a large and rapidly growing academic community, particularly in engineering and technology. Many universities and research institutions are focused on logistics and supply chain management, and these institutions are actively researching and publishing on the topic of shared logistics. Moreover, the country has strong government support for research and development in the logistics field, with many state-funded research projects being devoted to logistics and supply chain management. This support is likely to drive research in the field. Finally, Chinese companies may be more willing to share resources and collaborate than companies in other countries. This may be a cultural difference that could be driving more interest in shared logistics in China. The fact that the subject is most appreciated in China may mean that gains in efficiency and cost reduction are most appreciated in China, at the cost of a partial loss of individuality/privacy. It is worth noting that shared logistics is a relatively new concept, and the scientific literature on this topic is still evolving. As the field of shared logistics continues to grow, it is likely that research on this topic will become more diverse and will come from a wider range of countries and regions.

A tool that allows users to analyze and visualize the relationships between keywords in a set of scientific publications is VosViewer. It is a tool that helps to visualize the literature. It can be used to identify patterns and trends in the literature. We analyzed which keywords are commonly used together, how authors associate certain keywords with each other, and which topics are currently the most researched. Figure 3 shows the correlation between the words used in the abstracts of the researched publications and the correlation between them. The greater the variance, the more often the word was used. The thicker the line, the greater the correlation between the words.

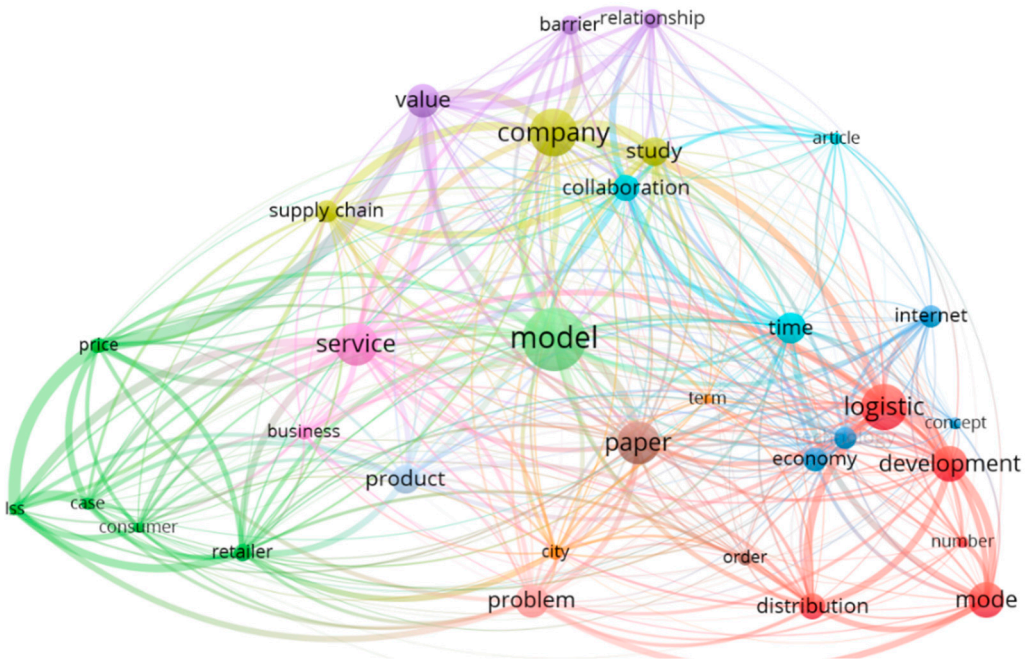

Figure 3. Repeated words correlation between abstracts of chosen papers. Source: Own work made in VosViewer program.

Figure 3 shows the most often model business services, supply chain services, and, added value concerning collaboration, and the relatively often research solutions for cities and model logistical problems for digital services concerning time and potential development. There is a visible, strong correlation between the words logistics, development, economy, and distribution. The connections between keywords used by authors provide a snapshot of the current state of the literature in the field. It can help identify the major

topics of research, and the relationships between different topics. It can also reveal areas where research is lacking or where there are gaps in the literature. Figure 4 shows three clusters of phrases that appeared together most often.

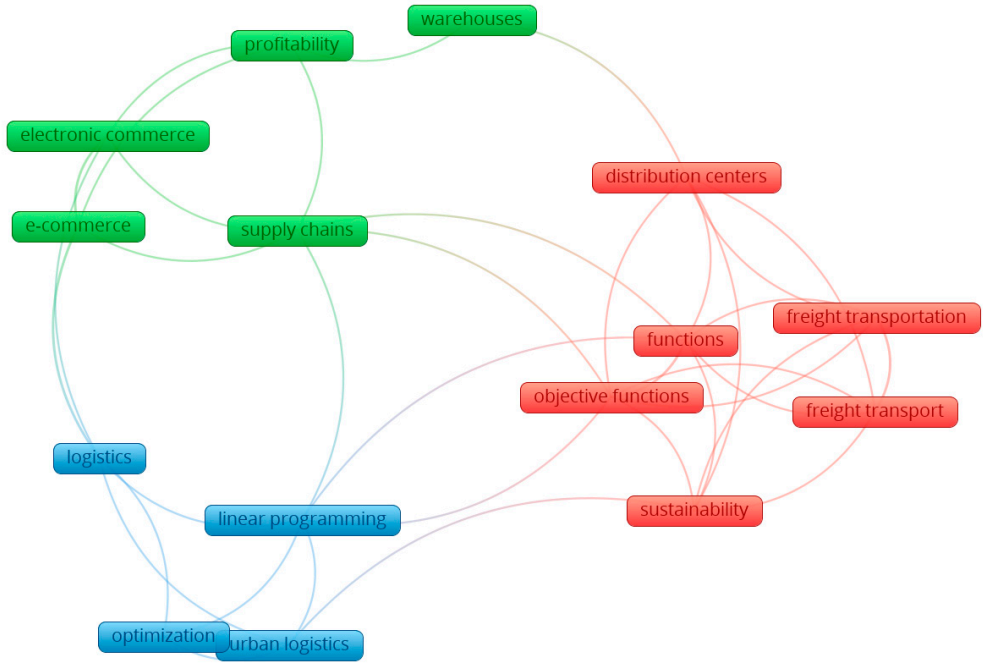

Figure 4. Three clusters of most common phrases used in association with each other in the analyzed papers of shared logistics. Source: Own work using VosViewer tool.

As the program does not show the correlation between the phrases, instead of shared logistics, we showed collaboration word links (Figure 5). If the center of gravity from the point of view of the keyword collaboration (the most commonly used synonym for shared logistics) is analyzed, there are connections with the concepts of the supply chain, time, services, modeling, company and value, product and retail, business, and logistics. While this is a superficial analysis, it gives a picture of research areas and areas of interest which can help to understand what the current trends in the field are and identify the most active research topics. Most articles deal with the area of computer sciences, then engineering, social sciences, business, and management, then environment and energy. The areas covered by the authors are presented in Table 1.

The table shows that digitalization, promotion of shared logistics, shared distribution, Physical Internet, shared storage, and shared logistics in urban space are the most common topics among the authors that have written about shared logistics. These topics are represented by multiple authors and papers, indicating that they are well-researched and widely discussed in the literature. Other areas that are also represented in the table include barriers in shared logistics, social aspects of shared logistics, cost sharing, revenue sharing, income sharing, profit sharing, shared packaging, sharing space in logistics, and fleet sharing. Additionally, general analyses on shared logistics are also represented, which includes topics such as sharing logistics mechanism modeling, optimal collaboration strategy, incidents of failure and success of logistics sharing, collaboration in logistics networks, and challenges for retailers. Some areas that are missing include safety and security issues in shared logistics processes, data security in shared logistics processes, and actual case studies of companies or organizations that have implemented shared logistics. The table provides a useful overview of the current state of the literature on shared logistics, but it is not a comprehensive list of all the topics and areas that have been explored in this field. The areas researched are also presented in Figure 6.

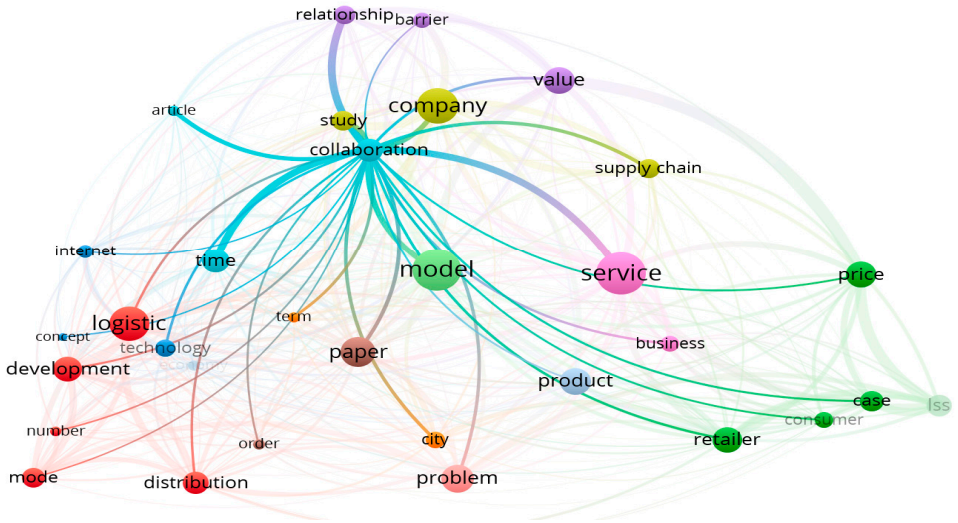

Figure 5. Links of correlation between *collaboration* and other words most often occuring in analyzed papers. Source: Own Work.

Table 1. Topics discussed in the area of shared logistics.

Area of Shared Logistics	Authors
Digitalization, including the following: • E-platforms; • Intelligent cyberphysical system; • Blockchain; • ICT in reducing warehouse waste;	Miao et al. [4], Mourtzis et al. [5], Ormanov [6], Shen [7], Xu et al. [8], Yaheng Cui [9], Zhang et al. [10], Jiang [11], Fang et al. [12], and Sun et al. [13] Pal and Kant [14] Lehmann et al. [15] Tornese et al. [16]
Promotion of shared logistics	Chu [17], Song et al. [18] and Zissis et al. [19]
Shared distribution	Cheng et al. [20], Guiyuan and Cho [21], Miao et al. [4], Sousa [22], Zhang, et. al. [23], and Zissis el al. [19]
Physical Internet	Pal and Kant [24,25] and Peng [26]
Shared storage	Jin et al. [27], Kim et al. [28], Lin [29], Rosenberg et al. [30], and Ma et al. [31]
Shared logistics in urban space, including the following: • Urban hubs; • Cooperative strategies in urban distribution; • Sharing logistics in sustainable city; • UCC; • Sharing space in goods and passengers transport.	Russo et al. [32] Carlos and Quintero [33] Van der Deen [34] Peddeu et al. [35] and Tomar [36] Adjei and Peprah [37], Fatnassi et al. [38], and Haselsteiner et al. [39]
Barriers in shared logistics	Karam et al. [40], Shin [41], and Tan [42]
Social aspects of shared logistics	Liu [43], Shin [41], Simunaniemi [44], and Tan [42]
Cost sharing, revenue sharing, income sharing, profit sharing	Luo et al. [45], Pan et al. [46], and Wang et al. [47]
Shared packaging	Zhang et al. [48]
Sharing space in logistics, including the following three areas: • Parking space; • Industrial site; • Port terminal.	Melo et al. [49] Madanhire and Mupaso [50] Yang et al. [51]

Table 1. *Cont.*

Area of Shared Logistics	Authors
Fleet sharing	Gopalakrishnan et al. [52] and Su et al. [53]
General analyses on shared logistics, including the following: • Sharing logistics mechanism modeling stochastic demand, revenue sharing, risk sharing; • Optimal collaboration strategy; • Incidents of failure and success of logistics sharing; • Collaboration in logistics networks; • Collaborative logistics as future of logistics; • Collaborative logistics effects; • Challenges for retailers; • Looking for improvement factors; • Mentioned as future trend; • Mentioned as carbon footprint decreasing factor; • Optimization technology to enable more efficient collaboration.	Wei el al. [54] Huang and Lee [55] Bennya [56] Karam et al. [40] Fikar and Leithner [57] Haag [58] Nero [59] Antonowicz [60] Volschenk [61] Curtois et al. [62]
Other areas analyzed by authors writing about shared logistics were as follows: • Case studies; • Circular economy; • Supply chain management in Industry 4.0, • Collaborative supply chain network for hospitals; • Pooling performance measured on different conditions of sustainability; • Payment management in shared logistics; • Competition in shared logistics; • Network of manufacturers.	Cavalho et al. [63], Donner and Vries [64], Aslan [65], Dorgham et al. [66], Mrabti et al. [67], He et al. [68], and Sellitto et al. [69]

Source: Own elaboration.

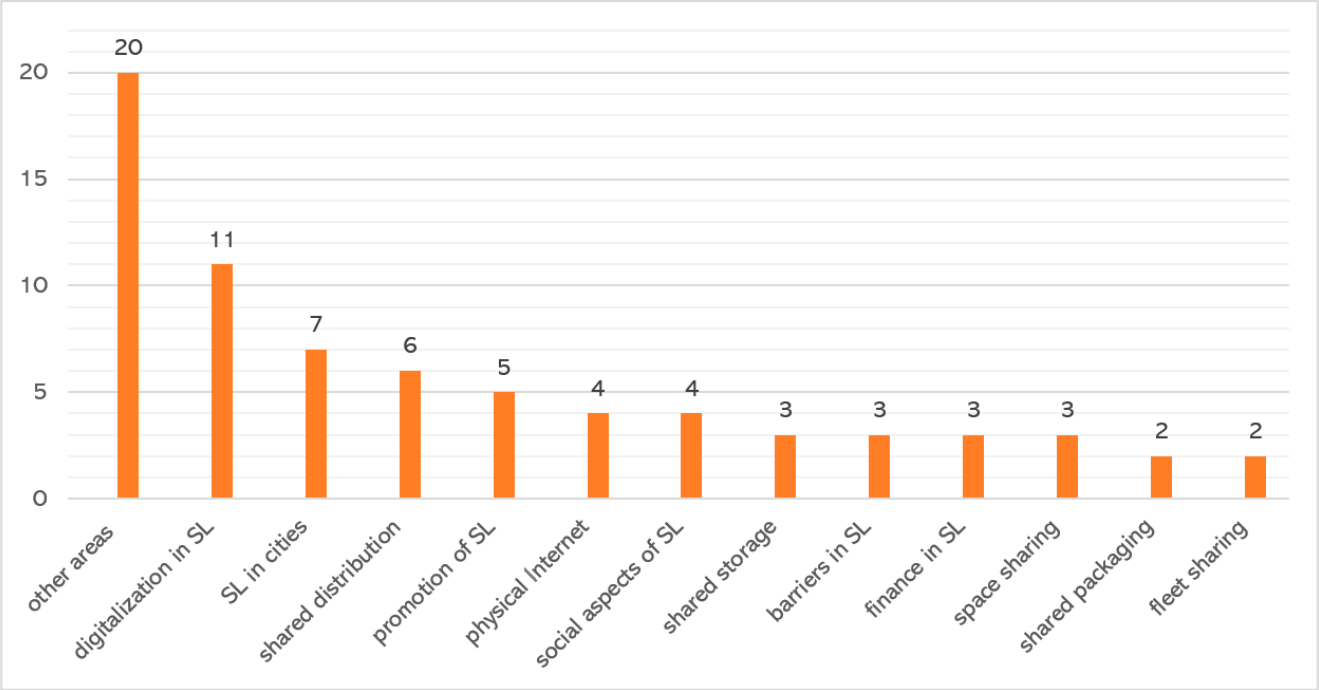

Figure 6. Areas of interest in the researched papers. Source: Own research.

3. Substantive Analysis

In this section, we present a substantive analysis of reviewed papers. We summarize the subjects in the area of shared logistics that were already researched and to what extent.

The paragraph outlines the existing knowledge. As one of the innovative ways of sharing logistics resources, joint distribution can not only improve the load rate of freight vehicles and reduce logistics costs but also relieve traffic and reduce environmental pollution. In their book, Karam et al. [40] describe the future of the transport industry as collaborative, technology-driven logistics. Cooperation in logistics means reducing empty runs and increasing the use of loading space in trailers, thanks to which external costs from road transport will be reduced. The most frequently raised problem when it comes to shared logistics is the fear of losing sensitive information. Yang et al. [51] propose an algorithm that can improve economic performance while protecting privacy in shared logistics payment management. The results showed that the algorithm can improve security in shared logistics concerning performance, user satisfaction, payback capability, and more. The research of these scientists shows that in the face of the current challenges facing logistics, it is sharing that will help to mitigate them.

3.1. Modeling of Shared Logistics

Visions of the future may sometimes be detached from reality, which is why papers in which attempts were made to model shared logistics are particularly valuable. Mrabti et al. [67] model a common supply chain, taking into account economic and environmental goals, different logistic costs, and different CO_2 emissions, social needs, external costs, and vehicle load factor. The article demonstrates the modeling results on an example with the participation of four cooperating suppliers. Cooperation between logistics companies is a simple and effective way to increase the efficiency of logistics operations. A study by Wang et al. [47] design the optimal cooperation strategy through collaborative delivery using eco-packages. Wei et al. [54] designed a mechanism for sharing logistics cooperation for express deliveries in conditions of stochastic demand. The authors took into account different operating and risk-sharing models. They model the sharing logistics scheme in the conditions of stochastic demand, excess supply, and shortage of supply, taking into account all aspects of the functioning of this business model. Ma et al. [31] created a model that allows the management of shared storage and shared vehicles. The authors of the model assumed the use of electric cars and additionally planned charging points to optimize the route and minimize costs. Jiang [11], using game theory, indicates how great benefits can be brought by a common logistics platform. Fang et al. [12] proposed a digital platform project for the B2B and B2C market based on a survey conducted among companies; therefore, the proposed marketplace conceptual framework takes into account the needs and concerns of companies. Zhang, et al. [48] compared two models dedicated and shared in packaging management in automotive parts logistics, and showed that total costs, transportation costs, and inventory costs are lower in the shared mode.

3.2. Case Studies

There were not many case studies in the articles studied. Therefore, the paper by Carvalho et al. [63], which examined the scope of cooperation between 191 Brazilian freight forwarders, logistics service providers [LSP], and carriers in logistics operations in urban freight transport. The study shows that among the three groups mentioned, LSPs are the most willing to cooperate. Zissis et al. [19] tested logistics-sharing models on empirical data sourced from a London retailer to demonstrate the importance of collaboration. The results suggest that in theory it is possible to collaborate and reduce economic, environmental, and social costs, but the implementation of these ideas remains a major challenge due to the extremely competitive nature of the grocery retail market.

3.3. Food Waste Reduction

A particularly difficult area in logistics is goods that require maintaining a certain temperature throughout the supply chain; therefore, this is an area where shared logistics can perform particularly well, a detailed analysis of such a variant is described by Kim et al. [28]. Pal and Kant [14] described the intelligent distribution of fresh food to reduce

waste, increase efficiency, and detect contamination, bacteria, or other threats. This delivery model is based solely on close collaboration, resource sharing between suppliers, and the use of technology. Tornese et al. [16] used ICT to reduce waste, both in warehouses and in sales.

3.4. Electronic Platforms for Shared Logistics

Most of the works reviewed were devoted to the concept of an electronic logistics platform for sharing resources in logistics. The functioning of the digital platform for sharing in logistics, the development of business alliances, and the exchange of information within the platform have been described by Sun J. and Sun L. [13]. Tomar [36] also dealt with the consolidation center as a manifestation of shared logistics, pointing to the special importance of the information system and a well-managed information platform. Another author discussing the subject of the logistics platform in the shared logistics service is Jiang [11], who claims that sharing different resources will bring huge economic benefits, as proven by the Bertrand Model and Game Theory. The use of technology and the Internet of Things [IoT] is essential in logistics today. Shared logistics must operate on the basis of an information platform. Zhang et.al. [23] designed one for maritime logistics to increase the efficiency and rationality of logistics processes. The platform is based on artificial intelligence, GPS, and automatic identification. The platform performs real-time positioning and monitoring of land and sea cargo, which greatly improves the efficiency of maritime logistics management.

3.5. Sharing Warehouses and Distribution Processes

Warehouses are the most frequently described shared resource. Jin et al. [27] discussed the possibility of sharing container storage space between different container handling companies in the port and proposed methods for efficiently allocating shared spaces between participating companies and sharing costs. Kim et al. [28] developed a sharing model that allows different companies to share logistics service centers located in regions with low storage and traffic needs. The proposed model took into account the distribution of profits and was verified with a case study. Rosenberg et al. [30] described micro depots that function as urban centers of consolidation and developed the concept of micro depots to include the functions of parcel machines. The network of such points allows logistics service providers to minimize costs and optimize the use of urban space. This article presents interesting case studies and identifies measures to evaluate the success of micro depot implementation, taking into account social, environmental, and economic goals. Madanhire et al. [50] present a case study of industrial plants in Harare to identify the potential for collaboration and symbiosis. Wang et al. [47] study the functioning of a shared warehouse and distribution process, and analyze the problem of profit sharing in a warehouse and distribution alliance. It has been found that by establishing linear time-based programming costing by activity, the problem of allocating scarce resources in transport enterprises can be rationally solved, and cost-accounting efficiency can be improved to achieve significant cost savings. The topic of cooperation based on capital in the supply chain of sharing logistics services is described by Luo et al. [45].

3.6. Live Labs for Shared Logistics

A common supply chain for a group of hospital sites was investigated by Dorgham et al. [66]. They created a model based on a horizontal logistics strategy of cooperation, thanks to which the group could minimize expenses, and optimize warehousing and distribution. Nero [59] has made an attempt to improve the business processes of quick service restaurants in India. It was identified that efficiency could be increased through shared logistics. If quick-service restaurants shared a logistics system, costs would decrease, fuel consumption would increase, vehicle utilization would increase, and pollution would decrease. All this leads to increased profits, and at the same time, is consistent with the idea of sustainable development. Huang and Lee [55] analyze how shared logistics

success and failure cases are investigated. The data are based on interviews with 35 business users in Taiwan in 2017. Ahmed et al. [70] describe opportunities for horizontal collaboration across industry sectors in Bangladesh to reduce traffic loads and increase the efficiency of their supply chain. Horizontal collaboration is characterized by the sharing of information, knowledge, risk, and profit between industries operating at the same level of the supply chain.

3.7. Shared Logistics for Sustainable Cities

The areas where shared logistics can be particularly useful are certainly the cities in which more than half of humanity already lives, and more than three-quarters of societies are in developed countries. In cities that are most often overcrowded, there are problems of congestion, pollution, and inefficient infrastructure. At the same time, we witness the increase in e-commerce, which makes deliveries even more heterogeneous, and disordered, carried out by various vehicles that have no space to park and unload the goods. Su et al. [53] propose to solve these problems using a common logistics platform. A mathematical formulation for maximizing the profit of dynamic planning adapting to dynamic priority was established, and a hybrid parallel distributed search algorithm combined with a search algorithm under demanding time constraint conditions was proposed. The study by van der Van der Deen [34] aims to answer the question of to what extent a shared logistics system with a common logistics hub can contribute to increasing a city's sustainability, with particular emphasis on the following factors: electricity, location, and availability. Russo et al. [32] provided guidance on the design of urban logistics hubs for shared use by multiple couriers, and express and parcel service providers. Various methods were used to collect a large amount of qualitative and quantitative data. Additionally, a case study from Vienna was presented. The research paper uses a linear optimization model to suggest the optimal allocation of shared infrastructure capacity. Pan et al. [46] described sharing along the last leg of the supply chain from the distribution center to customers in the city. The authors developed a model of functioning and allocation of income, taking into account a large number of stakeholders. Fatnassi et al. [38] explored the potential of the integration of the rapid transit of goods and passengers in urban areas. Although flows of people and goods have different goals and constraints, sharing the same network is in line with current trends to use available transport capacity more efficiently. A form of shared logistics is one of sustainable city logistics measures, i.e., urban consolidation center (UCC). Paddeu et al. [35] conducted a survey in Cagliari that investigated the propensity of potential users to join the UCC program. The comparison between the two cities takes into account factors such as the nature of the business model, operating practices (e.g., delivery pattern), and the operating sub-sector. Based on the concept of the collaborative economy, multi-stakeholder collaboration in UFT can be an effective tool to improve the quality of life in cities. Stakeholder participation is critical to the success of a shared delivery system. By sharing logistics facilities and delivery vehicles, stakeholders can benefit from UCC encouraged by cost and time savings and value-added services. However, the stakeholders involved in the city system have different needs and goals, therefore there is always a problem with financing such a center. The sharing economy provides flexible options for cost savings, pollution reduction, and social value. However, as the results of a survey conducted in Cagliari show, despite the potential benefits it can provide, it remains far from being widely accepted by potential users. According to the authors, communication and promotional campaigns should be organized to sensitize stakeholders to the benefits that the sharing economy can provide for their companies. Another issue with the success of shared logistics systems is cost allocation. Detailed analysis related to the identification of people benefiting from UCC is needed. Another important barrier is related to the propensity to change and the acceptance/aversion to risk. The type of goods can also be an obstacle, due to the needs and constraints of the cold chain.

3.8. E-Commerce and Retail

He et al.'s [68] study is on the sharing of logistics services between e-commerce companies. De Brito Sousa [22] has developed a model for planning the joint distribution of newspapers and e-commerce products for use by a logistics operator. Different scenarios of distribution outsourcing were analyzed, taking into account the impact of changes in demand on profitability, late payments, and fluctuations in costs. Collaboration between retailers was analyzed in the study by Haag [58], as well as between retailers and logistics service providers to better deal with logistics challenges in retail.

3.9. Rural Areas

As far as the region is concerned, the most frequent topic of shared logistics is authors from China, including resource sharing in agriculture. Cheng et al. [20] analyze the possibilities of shared logistics for the distribution of goods from rural areas. The article analyzes the sharing of resources, data, facilities, and equipment, and proposes a mechanism for the sharing system and an information platform. Additionally, they present an incentive mechanism. Song et al. [18] argue that shared storage and distribution among logistics companies should be developed and the integration of rural storage and logistics distribution resources should be promoted. This article examines the rural express delivery situation, assesses the efficiency of rural express distribution, and constructs a new way to operate rural express delivery in light of the related problems. In addition, the article provides an overview of the already existing rural shared logistics systems and presents appropriate ways to improve their development. In addition the study by Guiyuan and Cho [21] focuses on the topic of the joint distribution of rural goods. Miao et al. [4] analyzes the prospects for the development of the circular economy in China and propose the creation of an information platform that would provide information about the available space in containers for agriculture.

3.10. Circular Economy

One of the ways to reduce carbon emissions is to increase the efficiency of resource use by the circular economy. Miao et al. [4] propose an interesting solution to use the turnover box cycle sharing mode, using a shared e-platform. Donner and Vries [64] analyzed eight European business cases that contribute to the transition to a sustainable circular bioeconomy through the use of agricultural waste and the valorization of by-products. The authors point out that in the circular economy, sharing is a key trend.

3.11. Barriers against Sharing

Sharing logistics services certainly requires an open mind, which is why the Shin [41] study deserves special attention, which examines how companies create economic and social value through cooperation, and also draws attention to socio-technical barriers, in particular the conservatism towards competition dominating among companies. The article shows examples of how to overcome technical and social barriers to create common value from cooperating logistics systems. The future of urban logistics is not only about shared logistics, but the entire transport network will be a collaborative transport network. Karam et al. [40] describe barriers to the development of such a network. The barriers are categorized into business models, information sharing, human factors, collaborative decision support systems, and the market.

3.12. Promotion of Shared Logistics

Before starting a sharing project, a very important process is to promote such solutions. Simunaniemi et al. [44] describe peer-to-peer networking practices where entrepreneurs, researchers, and local public business consulting services seek to promote entrepreneurial behavior through collaborative activities such as idea sharing, peer learning, and business development. Information management is essential for a shared logistics venture to function effectively. This problem is investigated by Xu et al. [8]. Chu [17] proposes to improve

the distribution mode system by promoting joint distribution and improving the level of customer service-oriented services, from the dis-node planning aspects to distribution by sharing resources, to the use of technology in the distribution process.

3.13. Trends

Ding [71] analyzes trends and prospects for the development of the sharing economy in China. Wang et al. [47] focus their study on shared parking spaces. Melo et al. [51] listed this as a future trend. Antonowicz [60] lists shared logistics as a factor in reducing the carbon footprint.

3.14. Physical Internet as Future of Logistics

The highest form of shared logistics is the Physical Internet. The supply chains can be more efficient, resilient, and transparent by implementing industry 4.0 technologies [72].

Pal and Kant [25] proposed a web architecture for a fresh food distribution network to meet the key challenges of maximizing the freshness of the delivered product and minimizing waste. The physical architecture of the Internet (PI) is based on the fundamental assumptions of sharing infrastructure between different parties, standardized addressing of all entities, and modularized activity. In addition, according to Peng et al. [26], the Physical Internet (PI) provides a connected, shared, and adaptable logistics system that has great potential to significantly increase the reliability and resilience of supply chains.

Areas that may be worth more insightful analysis in the subject of shared logistics include the following:

- Fleet sharing: as it is one of the most common manifestations of shared logistics, and the fact that only two of the analyzed papers deal with the issue, more research on fleet sharing would be beneficial to understand the benefits, challenges, and best practices of this aspect of shared logistics.
- Safety and security issues: as shared logistics processes involve multiple parties and the sharing of resources, it is important to understand the potential security risks and how they can be mitigated.
- Barriers to implementation: understanding the reasons why companies may be hesitant to adopt shared logistics, and how those barriers can be overcome, would be valuable to help more companies implement shared logistics.
- Data security: as shared logistics involves the sharing of sensitive information among multiple parties, it is important to understand how data security can be ensured and how logistics agents can be convinced to share resources.
- Shared packaging: given the widespread efforts of companies to reduce waste and cut costs, understanding how shared packaging can be implemented and how it benefits the supply chain would be valuable.
- Fleet sharing in urban areas: as the density of the population and the infrastructure in the city is different from the rural areas, understanding how fleet sharing can be effectively implemented in urban areas would be valuable.

4. Discussion and Research Limitations

The purpose of the review was to summarize the existing research and concepts in the area of shared logistics from the period of 2017–2021. The goal of the review was to provide a benchmark for future researchers on what has been achieved and what has not been achieved on the topic, which approaches have already been tried, and what the results have been. The review also provides an important context for readers other than researchers about where science and practice are in the area of shared logistics. The review has been conducted using desk analysis, visual analysis, and benchmark datasets of approaches. We believe that our literature review will serve many researchers in the future to clarify the scope of their project and form a narrative about what is known and what is new. It will also avoid tried-and-tested approaches. For readers, the review provides an important context about where learning and practice are the areas of shared logistics. Our literature

review is informative and thematically arranged, which gives the reader a picture of the current state of knowledge.

In this paper, we presented an overview of the literature on shared logistics and its features. Processes of shared logistics and forms of logistics collaboration have been well described in the scientific literature. The number of articles relating to shared logistics grows in the following years within the analyzed period of 2017–2021. The thematic areas in the analyzed articles were highly related to the digitalization of processes, which seems to be a factor particularly conducive to the idea of shared logistics. Other significant areas of analysis were the issues of shared logistics in urban areas, shared distribution services, and shared logistics promotion. Surprisingly, only two of the analyzed papers deal with the issue of fleet sharing, in spite of the fact that fleet sharing is one of the most common manifestations of shared logistics mentioned in the definitions. There was also little mention in the articles reviewed on the subject of shared packaging, which seems to be particularly important given the widespread efforts of companies to reduce waste and cut the costs of packaging. These areas, therefore, need to be further explored, together with the safety and security issues in shared logistics processes. It is worth paying attention to the fact that the most frequently discussed topic seems to be the simplest in relation to the whole subject of shared logistics–electronic platforms supporting sharing. There are also many papers that describe how storage and distribution could be shared. The fewest papers are devoted to barriers that may be encountered by the implementation, and there are many of them. Companies are reluctant to change the status quo or share their resources, as well as about the security of their data. This is another aspect that the literature devotes little time to, namely, how to ensure data security and how to convince logistics agents to share resources.

The authors believe that their literature review will serve many researchers in the future to clarify the scope of their project and form a narrative about what is known and what is new. It will also avoid tried-and-tested approaches. The review is relevant for many reasons:

1. Shared logistics refers to the concept of sharing resources and infrastructure in logistics operations, such as transportation and warehousing, in order to improve efficiency and reduce costs. By conducting a literature review in this field, we provide a comprehensive understanding of the current state of research and identify gaps in the existing knowledge.
2. Shared logistics is a rapidly developing field with growing interest from academics and industry practitioners. By conducting a literature review, one can stay updated on the recent development in the field and identify the current trends and challenges.
3. Shared logistics can have a significant impact on the environment and society, by reducing the number of vehicles on the road, improving the use of resources, and reducing the carbon footprint. A literature review can identify the existing research on the environmental and social impact of shared logistics, and guide future research in this area.
4. The literature review in shared logistics provides valuable insights for practitioners and policymakers who can use the information to develop more effective and sustainable logistics operations.

Our work makes a valuable contribution to the current knowledge as shared logistics has not been well covered in previous reviews. The review has been conducted for a specific time period and covers the most recent developments and trends in the field. However, it is important to note that any literature review is a general overview of the field and covers topics that have been analyzed in the papers. It is also worth noting that our literature review is still valuable and useful, as it can provide an up-to-date overview of the field and identify gaps in the existing knowledge.

The studied works show that shared logistics can bring benefits in terms of cost savings and environmental sustainability, but challenges such as socio-technical barriers to cooperation among companies and the need for effective information management

need to be addressed in order to fully realize these benefits. Additionally, some studies discussed in the text also highlight the challenges of maintaining a certain temperature throughout the supply chain, reducing waste, both in warehouses and in sales, dealing with logistics challenges in retail, and routing optimization algorithm and non-standardized logistics processes. It can be inferred that the studies and papers discussed in the review show that shared logistics can bring benefits in terms of cost savings and environmental sustainability. The studies present evidence that shared logistics can bring lower total costs, transportation costs, and inventory costs. It can also lead to lower CO_2 emissions and external costs. Additionally, shared logistics can help in the distribution of goods from rural areas, valorization of by-products in circular economy, and promoting shared logistics through peer-to-peer networking practices and effective information management. The analyzed studies show that shared logistics can help in reducing waste, increasing efficiency, detecting contamination, bacteria, or other threats, and improving the distribution of goods.

The detailed analysis of literature on the subject of shared logistics shows the existing gap in terms of the topics of security of assets and data sharing, concerns about safety and security issues in joint logistics operations, and most of all, ways to encourage companies to take part in shared logistics projects. Safety and security issues are also of critical importance for information sharing in a supply chain, which is referred to as the extent to which crucial and/or proprietary information is available to other members [73]. The extent of shared information can be classified as either tactical [a low level of information sharing that can satisfy basic operation needs] or strategic information (a high level of information sharing that can satisfy strategic and competitive needs) [74]. The topic for further research would also be whether it is possible for state-owned companies to participate in shared business processes, with their infrastructure and fleet base, and other assets to improve their utilization levels. More case studies of logistics collaboration to compare the quantitative and qualitative effects of joint projects with the situation of individual operational development would be worth considering.

The literature review is based on a generalization, which refers to making broad statements or conclusions based on analysis. This generalization does not take into account the limitations of the data and the methods used in the analyzed studies. Scientific conclusions should be based on evidence and should and therefore any review might omit some important and unique findings.

A certain limitation is the fact that we decided to limit our research to the phrase "shared logistics", not "collaborative logistics" as we noticed authors who use the phrase "collaboration" and "collaborative logistics" use the "shared logistics" phrase as an umbrella term. Authors often use the term *collaborative logistics* or simply *collaboration* in logistics interchangeably and also, collaboration is usually perceived as part of shared logistics or action from the field of shared logistics. Collaboration has been defined as occurring when "two or more independent companies work jointly to plan and execute supply chain operations with greater success than when acting in isolation" [75]. Collaboration may take place between various types of entities in supply chains. Two types of collaborative relations can be distinguished: vertical collaboration, when the company collaborates with customers, internally [across functions], with service providers, and with suppliers; and horizontal collaboration, which takes place between different supply chains when cooperating with competitors and with non-competitors [58,76]. However, due to the shared economy trend, the term *shared logistics* is more popular in the industry, therefore we decided to limit our methodology to be based on this phrase by searching for it in the Scopus database and Google Scholar.

5. Answering the Research Questions

5.1. What Topics Related to Shared Logistics Are Covered?

The most frequently discussed topics are digital tools that facilitate the implementation of shared logistics; most often they are digital platforms that propose connecting all stakeholders to a common network, where they can share information and even assets. A

higher degree of cooperation and digitization in logistics is the Physical Internet, which the European Commission defines as a future logistics target enabling decarbonization, declaring that it will support a smooth transition to this model. This area is also noticed by researchers, but to a small extent.

5.2. In Which Regions of the World Is This Innovation Particularly Appreciated?

Most of the authors come from China. Interpretation of this fact, however, can only be intuition; perhaps researchers from this area, due to the high population density, are particularly aware of the fact that the only possibility to increase efficiency with the growing number of populations in an unchanged area of space is by sharing assets.

5.3. Is the Topic More often Treated as the Subject of Modeling, or Are Concepts and Visions of Future Frameworks Drawn?

More works are modeling, which makes their implementation real, but in our opinion, the role of concept papers should not be diminished, because in order to model something, concepts must be presented. Concepts can be modeled in a wide variety of directions, from cost-benefit sharing models to using game theory to try to predict the behavior of other players. The modeling work shows the real possibilities, and the conceptual work opens up more avenues for further study.

5.4. What Areas of Shared Logistics Are Not Sufficiently Covered in the Literature?

According to many studies, empty mileage is one of the biggest logistical problems. Empty loading space means empty mileage, increased emissions with no added value, as well as external costs, such as noise, accidents and road wear, without trade-offs. Filling the loading space completely would eliminate a large proportion of vehicles from roads, reduce emissions of harmful substances, and increase safety. This is a difficult topic because entrepreneurs do not want to share their assets if they have invested in them themselves. In addition, they are afraid that by sharing something physical, they will also lose some intangible value such as intellectual or sensitive values. The area of fleet sharing seems to be the most neglected because it is the most difficult one. There is also a substantial amount of work to be carried out with regard to making LSP entrepreneurs aware. Entrepreneurs should be persuaded that sharing can also bring benefits for them, e.g., reducing costs with at least the same profits.

5.5. What Are the Recommendations for Future Publications?

The answer to the previous question prompts the answer to this question. Modeling regarding fleet sharing, shared reusable packaging and therefore the Physical Internet, is needed. The Physical Internet is not only a model of the functioning and a common digital platform in which the system [algorithm] decides about the route and means of transport, but also modular packaging, filling the pallet in a truck. Just as containers revolutionized international transport and trade in the 1960s, we need standardization for smaller packaging. With e-commerce growing so rapidly, accelerated by the pandemic, the small boxes into which our orders, e.g., from Amazon, are packed, come in dozens of shapes and sizes. The Physical Internet assumes the use of only nine types of small boxes that can be placed on a pallet in various ways, such as Tetris dice, where they are held with a click, such as containers on a container ship. It seems that this is an area to be used by researchers, and therefore Physical Internet development models, not only in relation to e-platform design but also in relation to the use of these modular boxes. We need research that will propose how the Physical Internet can function in practice, where entrepreneurs report a demand, and the system selects the most optimal and most sustainable options in terms of costs, time, and environmental burden, and additionally use the modular PI boxes.

6. Final Remarks

Today, one of the main challenges of the world and therefore science, is to curb climate change and the planet's warming, which poses a threat to humanity in the form of natural disasters, unbearable temperatures, threats to crops, and the need to migrate. One way to mitigate climate change is to make better use of existing resources, using resources to the maximum of their potential, so as not to waste energy and space. Shared logistics is one of the methods of using resources to the maximum of their potential, not to invest in new ones (cars, warehouses), but to use the existing ones to the maximum, based on extensive cooperation between entities that have competed so far: cooperation on the road, or more broadly, in the supply chain, competition on the store shelf. The choice of topics shows that scientists tend to choose what is less challenging. The straightforward way is to describe the concept of a digital platform dedicated to logistics service providers and shippers. Research shows that entrepreneurs react with the greatest resistance when they have to share something, and there are only two research papers on fleet sharing and shared packaging, which makes it a significant gap to be filled by researchers.

Our work provides a comprehensive summary of current knowledge and research on shared logistics, highlighting key areas that have been studied and areas that require further research. Practitioners in various industries can benefit from our work by understanding the potential advantages of shared logistics for their supply chains and identifying areas where they can improve their own logistics operations. The topics we discussed can help practitioners understand the benefits of cooperation and optimization in logistics, and how to implement these concepts in their own operations. Additionally, our analysis of barriers to implementation and data security can help practitioners identify potential challenges and solutions in implementing shared logistics.

Society can benefit from our work by understanding the potential of shared logistics to mitigate climate change and make better use of existing resources. Our work highlights how shared logistics can help to reduce waste and increase efficiency in logistics operations, which can have a positive impact on the environment. Additionally, by highlighting the potential for fleet sharing and shared packaging, our work can inspire new solutions for reducing emissions and energy consumption in transportation.

Our work provides valuable insights and understanding of the current state of shared logistics research, and can help practitioners and society to improve and optimize logistics operations, and ultimately contribute to mitigating climate change and promoting sustainable development.

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