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NEW TRENDS IN SUSTAINABLE SUPPLY CHAINS: INSIGHTS FROM RECENT STUDIES

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Abstract: *Research on the Sustainable Supply Chain is a significant focus within the academic community, highlighting the importance of smart logistics, smart transportation, and digital technologies. This paper reviews current research trends from 2014 to 2023 by analyzing publications from the Web of Science database. The bibliometric analysis covers publication counts, document types, top-cited papers, leading journals, main funding sponsors, and distribution by subject categories, countries, and institutions. Additionally, co-authorship and keyword co-occurrence were examined to identify key knowledge components and research clusters. The analysis underscores the need for expanded international research and continuous integration of Sustainable Supply Chain concepts for future development. The goal of the document is to provide a comprehensive review of research and industrial trends and key insights in the fields of smart logistics, smart transportation, and digital technologies in recent years.*

Keywords: *smart logistics, smart transportation, digital technologies, sustainable supply chain*

1. INTRODUCTION

Smart digital technologies are very important to today's Industry 4.0 principles, which create a more interconnected, automated, and holistic manufacturing ecosystem, enhancing efficiency, productivity, scalability, security, privacy, and autonomous operations by enabling direct interaction among various components, including equipment, logistics systems, work-in-progress components, and people [1]. The UN predicts the global population will reach 10 billion within the next century, mostly in urban areas, posing significant challenges [2]. By 2030, 59% of the global population will live in urban areas [3]. The forces of disruption and innovation drive contemporary societies [4]. The logistics function in supply chain management ensures the seven R's (Right Product, Right Customer, Right Price, Right Quantity, Right Quality, Right Time, Right Place) to the end customer [5]. With the shift from traditional supply chains to open networks, organizations focus on smart

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products and services to maintain complete visibility and proactive management of planning, production, and logistics activities [6]. Although the concept of smart logistics is still evolving [7] its definition varies with the era, innovation, and technology adoption [8]. For example, having electricity in homes in the 1900s was considered smart [9], and post-COVID-19 online education is now viewed as smart. Thus, smart products and services are technology-driven innovations for domestic and commercial use.

The Internet of Things, one of the key methods of Industry 4.0, is expected to significantly impact supply chains, business models, processes, productivity, and lead times [10]. Smart logistics is essential for the fourth industrial revolution, using advanced technologies to ensure accurate delivery of products, information, and services [11]. While previous studies have mainly focused on technology and engineering perspectives of smart logistics, recent efforts aim to implement it to improve supply chain efficiency and competitiveness [6].

Bibliometric analysis, a powerful tool for identifying influential scholars, affiliations, and academic relationships, provides a systematic representation of research. This study aims to use bibliometric methods to acquire transparent bibliographic information on smart logistics and its impact on sustainability in supply chain management. Bibliometric analysis helps understand cognitive structures and intellectual relationships by evaluating documents, authors, countries, journals, and institutions [12]. It identifies topics relevant to social, economic, and environmental sustainability [13] and has been applied across various fields, including engineering, sustainability, industry, Industry 4.0, Blockchain, and Artificial Intelligence [14-17]. This evaluation describes smart logistics as a technology-oriented process aimed at enhancing supply chain efficiency in both upstream and downstream operations.

2. MATERIALS AND METHODS OF THE REVIEW PROCESS

In this review, we examined publications from the Web of Science database from 2014 to 2023 using keywords "smart logistics," "smart transportation," and "digital technologies in logistics." In February 2024, we analysed almost thousand publications using CSV files, Microsoft Excel, RIS, VOS viewer, and Map Chart.

We included articles in English with the specified keywords, spanning subjects like Computer Science, Engineering, Transportation, Business Economics, and more, up to December 2023. Exclusion criteria included articles with non-English content beyond titles and abstracts, unrelated research areas, and articles without DOIs. This bibliometric analysis identifies key scholars, affiliations, and trends in the field, offering a systematic research representation.

Data in CSV format was uploaded to Excel for bibliometric analysis. We identified the most relevant articles and authors: Zhang Y. and Kumar N. leading with 9 articles each. The analysis categorized papers by year, document type, top journals, funding sponsors, subject areas, countries, and institutions. Co-authorship and keyword co-occurrence were analysed to reveal research clusters.

The review found 821 papers published between 2014 and 2023, showing two development periods: introduction (2014–2018) and stable growth (2019–2023). The introduction period (229 publications) focused on initial problem-solving and cost savings in smart logistics and transportation. The stable growth period (592 publications) highlighted increased scientific interest, with significant research strengthening in 2020 and 2022.

Smart logistics and transportation are critical for urbanization, efficiency, and competitiveness [18]. Recent studies emphasize intelligent and sustainable transportation, traffic monitoring, IoT-driven systems, and advanced traffic control methods as vital for modern cities [19]. This review shapes the future role of smart logistics and transportation, summarizing digital technology research connected to various sectors, including healthcare, industrial systems, smart factories, and smart cities [20].

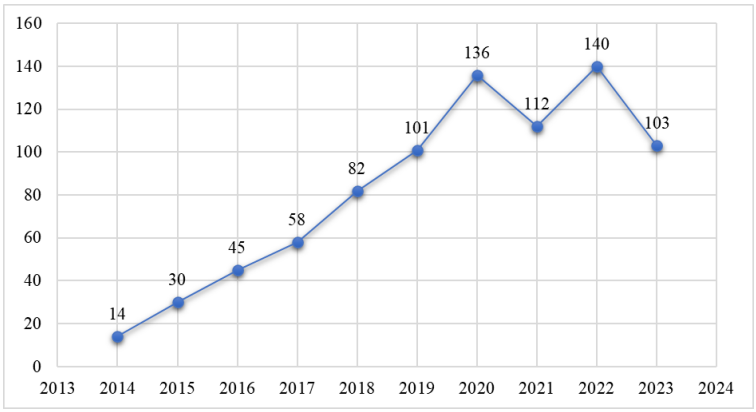

Figure 1. *Annual production of articles on smart logistics, smart transportation and digital technologies in logistics during the period 2014-2023*

Our research found that 501 authors from 82 countries conducted studies on smart logistics, smart transportation and digital technologies in logistics over the period 2014-2023. Figure 4 shows 15 authors who have published more than 4 papers. Among them, Zhang Y. and Kumar N. reigned with 9 publications, followed by Liu Y. and Djahel S. with 7, Bahnasse A. with 6, Zhang SY., Zhang L., Yu JJQ., Wang FY., Tanwar S., Ouajji H., Kim J., Khiat A., Das D., with 5, Chen X. with 4 papers. This can be seen in Figure 2.

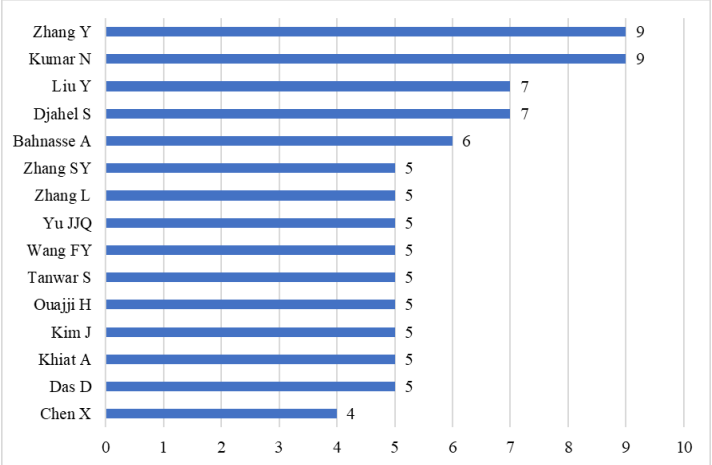

Figure 2. *List of top authors published on smart logistics, smart transportation and digital technologies in logistic*

From 2014 to 2023, the top sixteen countries in research on smart logistics, smart transportation, and digital technologies produced varying numbers of publications. China led with 212 publications, followed by the USA with 137, India with 82, England with 57, Australia with 47, Canada with 42, Saudi Arabia with 37, South Korea with 37, France with 33, Germany with 29, Spain with 25, the UAE with 23, Taiwan with 22, and Brazil with 19.

Table I.

List of top countries on smart logistic and transportation, digital technologies in logistics

Countries	**Record Count**	**%**
China	212	25,82
USA	137	16,69
India	82	9,99
Italy	72	8,77
England	57	6,94
Australia	47	5,73
Canada	42	5,12
Saudi Arabia	37	4,51
South Korea	37	4,51
France	33	4,1
Germany	29	3,53
Spain	25	3,045
United Arab Emirates	23	2,4
Taiwan	22	2,68
Brazil	19	2,31

The fifteen most-cited papers on smart logistics, smart transportation, and digital technologies in logistics worldwide are shown in Figure 3. These fifteen papers have collectively received approximately 3,865 citations. Among these top-cited works, there are eleven research articles and four review papers. The list of most-cited papers shows that one was introduced during the period 2014–2018, while the remaining fourteen were published during the stable growth phase from 2019–2023.

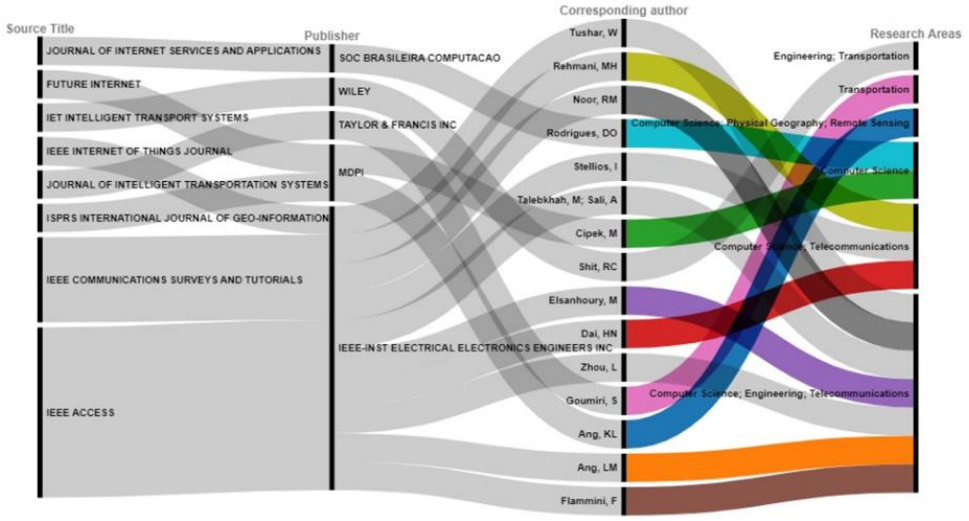

Figure 3. *Top authors collaboration with source, publishers and research areas on smart logistics, smart transportation and digital technologies in logistics*

3. DISCUSSION

The objectives of this study were to analyse the existing knowledge on smart logistics, smart transportation, and digital technologies in logistics, and to identify, through a systematic review, the scientific articles and research areas that have had the greatest impact on these topics. The scientometric analysis revealed that articles published over the past decade have achieved the highest impact in studies related to smart logistics, smart transportation, and digital technologies, particularly in the last five years. The annual production of articles from 2014 to 2023 can be divided into two periods: the introduction phase (2014–2018) and the stable growth phase (2019–2023). During the introduction phase, interest in these themes began with a focus on problem–solution relationships. The stable growth phase highlighted the growing importance of smart logistics, smart transportation, and digital technologies, showing a strengthening of research in various related topics.

The analysis indicates that China leads in terms of institutions, authors, countries, and funding sponsors for research in smart logistics, smart transportation, and digital technologies. Chinese scientific organizations rank first, with 212 (25.82%) articles, reflecting the country's position as one of the world's developed nations, with numerous prestigious research centers and universities. China, the world's second-largest economy by nominal GDP and the largest by purchasing power parity since 2016, accounted for 19% of the global economy in PPP terms and around 18% in nominal terms in 2022.

In general, the study aims to maintain a focus on smart logistics, smart transportation, and digital technologies in logistics. From an analysis of publications over 15 years, 821 articles on these topics were identified, published between 2014 and 2023. These articles addressed issues such as on-street parking systems [21], data collection [22], e-commerce logistics [23], delivery operations [24], using smart card data [25], electrified vehicles [26], autonomous vehicle intelligent systems [27], energy management in smart cities [28], blockchain for intelligent transportation systems [29], route choice stickiness of public transport passengers

[30], real-time urban transport management [31], systems for smart cities [32], smart mining operations [33], enhancing vehicle state recognition in logistics [34], and smart logistics [11]. These topics are covered in journals such as Supply Chain, Logistics, Transactions on Intelligent Transportation Systems, Internet of Things, Intelligent Transport Systems, Transactions on Vehicular Technology, Electrical Engineering, Tools and Applications, e-Logistics and Transportation Review, Transportation Planning and Technology, Science and Engineering, Transportation Business and Management, Mobile Networks, Vehicular Communications, Sustainable Transportation, Industry, Transportation Engineering, Traffic, Agriculture, Environmental Monitoring, Ecology, Distribution, Management, Supply, and Optimization.

The study also highlights the connection between smart logistics, smart transportation, digital technologies, and issues related to sustainable supply chains. Over the past decade, 821 articles were sorted, with nearly 90% of them focusing on advanced technologies for sustainable supply chains.

4. CONCLUSIONS

This study focused on smart logistics, smart transportation, and digital technologies in logistics, highlighting research hotspots and potential future directions globally from 2014 to 2023. Using bibliometric approaches based on the online Web of Science database, we collected, reviewed, and analyzed 821 publications. Our findings show that the majority of the papers were articles (59.44%), followed by proceeding papers (38.12%), review articles (3.4%), early access papers (2.56%), book chapters (0.6%), editorial material (0.24%), and retracted publications (0.12%). The steady growth in the number of articles between 2019 and 2023 indicates increasing attention to these topics, with 72.11% of the total documents published during this period. The peak number of publications was reached in 2020 with 136 articles, followed by 140 in 2022, illustrating a consistently growing field.

China contributed the most publications, followed by the USA, India, England, Australia, Canada, Saudi Arabia, South Korea, France, Germany, Spain, the UAE, Taiwan, and Brazil.

Through this analysis, we identified several limitations:

- Shortages and business-critical price increases for key resources.
- Increasing cost of order processing in e-commerce due to the complexity of processes. Sales channels in e-commerce are evolving, but effective collaboration with marketplaces remains challenging.
- Extended delivery times (lead times), which encompass demand processing, product availability, and delivery.

Potential solutions to reduce delivery times include automating processes, reducing order processing times, establishing long-term supplier relationships, creating flexible approval matrices for transactions, and eliminating outdated approval cycles.

Inadequate data exchange systems and lack of international cooperation, leading to a scarcity of joint projects, are significant challenges.

The primary audience for this paper includes business entities, producers, suppliers, policymakers in logistics and transportation, academic and government researchers, and the general public. Proper management of these issues can foster more international collaborative projects and new publications in logistics, transportation technologies, and other related fields.

Future international research on smart logistics, smart transportation, and digital technologies in logistics would benefit from increased scientific exchange, especially between emerging and developed countries, suppliers and buyers, and stakeholders and scientists.

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