

Smart Logistics for Sustainable Supply Chain: A Bibliometric Analysis

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Abstract. This study undertakes a bibliometric analysis of 143 documents on smart logistics research from 1998 to 2023. Quantitative techniques encompassing publication trend analysis, keyword co-occurrence, conceptual structure mapping, and bibliographic coupling are applied using RStudio and VOS Viewer. The results reveal rising publications since 2019, with China and the USA as leading contributors. Dominant keywords include smart cities, sustainability, logistics, and transportation systems. Concept mapping highlights an enduring emphasis on the smart logistics research cluster. While insightful, limitations exist regarding the sole use of Scopus and the dataset constraints. Further studies incorporating co-citation analysis after sufficient and accumulating publications can provide a more comprehensive perspective.

Keywords: Smart Logistics, Sustainability, Bibliometric, Coupling

1. Introduction

The foundational doctrines of contemporary societies are now firmly anchored by the forces of disruption and improvement through new innovative and competitive ideas (Craighead et al., 2020). The trend of disruptive incidents, spanning from those arising through human to those stemming from nature, has demonstrated in long term. Organizations and societal frameworks are increasingly seeking innovative products, methodologies, services, and commercial paradigms to survive and surpass rivals (Oke & Nair, 2023). Logistics function of supply chain management proves itself as a backbone (Esper et al., 2007) to provide the product by ensuring the all five R's (Right Product, Right Quantity, Right Quality, Right Time and Right Place) to the end customer (Barrington, 2019; Hosseinzadeh Lotfi et al., 2023). By keeping in view the major shift from traditional supply chain to open supply chain network, organizations are working on the smart product and smart services to ensure the complete visibility of the products and services so that they can proactively manage their activities of planning, production and logistics (Chowdhury et al., 2018; Kolasińska-Morawska et al., 2022). The discussion of smart products and smart services has led towards the smart logistics but the debate is still open when thinking about the definition of smart logistics (Uckelmann, 2008). Uckelmann (2008) talked about the intelligent and agent bases logistics but the smart logistics is the function of providing goods and services to the end customer by using innovations, which are technology driven. The word "smart" depends upon the era, deployment, and adoption of innovations and technologies (Rehman Khan et al., 2022). In 1900s, having an electricity in houses called smart house (Dingli & Seychell, 2015). Nowadays, after COVID 19, a shift in education sectors from traditional ways of teaching and learning towards a smart and technology driven, online education is also an example of smart. Hence, the smart product or smart services are a technology driven backed by innovation and available for domestic and commercial use. Therefore, the definition of smart logistics is still to be explored more (Uckelmann, 2008).

Industry 4.0, also known as the Internet of Things, is expected to significantly impact supply chains, business models, processes, productivity, and lead times (Abdirad & Krishnan, 2021). Kayikci in (2018) reported the transformation of industry 4.0 for organizations in Turkey, enhancing production and logistics. He also explained that sustainability requires vertical and horizontal integration, particularly in FMCG companies and transport service providers. Smart logistics is crucial for the fourth industrial revolution, utilizing advanced technologies to ensure accurate product, quantity, place, time, cost, quality, and information (Issaoui et al., 2021). In previous studies, smart logistics for the operation in supply chain and its sustainability for the supply chain is discussed in very less. Most of the time, researchers discussed smart logistics for in perspective of technology advancement or engineering (Arumugam et al., 2018; Bag et al., 2020; D'Amico et al., 2021; Issaoui et al., 2021; Pozzo et al., 2022)

Nowadays, organizations are in transformation phase and trying to implement smart logistics to improve the efficiency of supply chain management and to gain the competitive advantage (Kolasińska-Morawska et al., 2022). BMW is a biggest example who uses the cutting-edge information system to visualize logistics and supply chain processes (Ludwig & July 2017).

Subsequent research questions were formulated to address this objective.

RQ1. What are the prevailing publication trends and the most pertinent sources in the field of "Smart Logistics for the Sustainability of Supply Chain Management" research?

RQ2. How do keywords co-occur, and what is the temporal pattern of word frequency?

RQ3. What are the noteworthy emerging subjects and the most widely referenced documents in this field, along with the countries that exhibit the highest rankings in terms of output, citations, and collaborative initiatives within this realm?

RQ4. How has the conceptual framework of "Smart Logistics for the Sustainability of Supply Chain Management" evolved over time?

Smart logistics, utilizing IoT, ICT, and AI, enhances global collaboration and operations, requiring further research for visualization, collaboration, and optimization (Feng & Ye, 2021). This is the first objective of this study to perform a bibliometric knowledge and trend-based analysis. The study aims to fill the knowledge gap in smart logistics for supply chain management and expedite its intellectual and knowledge-based development through bibliometric analysis. Bibliometric is the best tool to identify influential scholars, their affiliations, and relationships in academic works, providing a transparent and systematic representation of research. Below are the research objectives (RO) of this study.

RO1. To identify the publication trends and the most pertinent sources in the field of "Smart Logistics for the Sustainability of Supply Chain Management" research.

RO2. To identify the keywords that co-occur and their temporal pattern of word frequency.

RO3. To identify the emerging subjects and the most widely referenced documents in this field, along with the countries that exhibit the highest rankings in terms of output, citations, and collaborative initiatives within this realm.

RO4. To explain the evolved conceptual framework of "Smart Logistics for the Sustainability of Supply Chain Management over time.

The literature on logistics 4.0 is limited, with studies focusing on industry 4.0's impact on logistics and sustainable supply chain management. Current studies explore technology's impact on smart logistics and sustainable supply chain management present a structured systematization of smart logistics (Pozzo et al., 2022).

Henceforth, this study has addressed a significant gap in the existing research through the application of trend analysis, conceptual mapping analysis and bibliometric coupling. By employing these methodologies, the study has contributed to a more comprehensive and nuanced understanding of the field of smart logistics research within the timeframe spanning from 1998 to 2023. An analysis was executed using the R studio of R package, complemented by the utilization of Biblioshiny—a web-based shiny app—for constructing visual aids such as conceptual structure maps, topic analyses, word treemap, and word clouds. Additionally, bibliometric-coupling analysis was conducted using VOS Viewer version 1.6.19. Within this bibliometric assessment, smart logistics for enhancing sustainability in supply chain management is conceptualized as a technology-driven logistical function that contributes to the optimization of supply chain performance across upstream and downstream operations.

The forthcoming sections of this manuscript delineate the research framework. Chapter 2 expounds upon the research methodology and design, while chapter 3 presents analysis and findings, chapter 4 discussion, future research recommendation and limitation of the study and chapter 5 presents conclusion of the study.

2. Methodology

2.1. Methodology

This study employs bibliometric analysis to analyze the current knowledge base on smart logistics in sustainability of supply chain management, a systematic method used to identify influential scholars, their affiliations, and relationships in academic works, providing a transparent and systematic representation of research. Bibliometric analysis is a widely used quantitative tool for managing large data sets, identifying trends in article and journal performance, research constituents, and intellectual structure, and effectively presenting it in a highly effective manner (Donthu et al., 2021a). We used performance analysis and science mapping techniques which are the main techniques of the bibliometric

analysis ((Donthu et al., 2021a)

A descriptive method used in bibliometric studies to evaluate the contributions of research constituents to a field is performance analysis. It is frequently used in reviews to assess productivity, impact, and influence such as publication related trends, citation analysis, collaboration analysis, co-authorship publication however science mapping examines research relationships by employing techniques such as co-authorship and citation analysis, co-citation coupling analysis, and network analysis to present the bibliometric and intellectual structure of the research field. (Donthu et al., 2021a).

This research is used widely accepted data for academic research, Scopus, which provides the researchers a huge range of research database of different domains like management, business, accounting and finance, psychology and social sciences other than Web of Science (WoS) (Jamshed & Majeed, 2022). Bibliometric methodology is a quantitative technique which encapsulate the different techniques like word trend analysis, year to year trend analysis, conceptual analysis, citation analysis and coupling analysis (Donthu et al., 2021).



Fig.1: Final Research Query Output

2.2. Research Design

The literature development process involves a set of criteria based on the field of study and the chosen documentation. The research was conducted using Scopus' academic database, selecting works published since 1998, as there was no single article on smart logistics before 1998. The refinement process included analyzing titles, abstracts, and keywords. Three relevant clusters were identified: "Logistic 4.0," "Smart Technological Innovations," and "Smart Logistics Applications in Supply Chain." After this, only 143 contributions remained. Output of the query as shown in figure 1, which shows the time span of 1998 to 2023, with a total of 143 documents, 475 authors, 561 author's key words, 7107 citations and 66 sources.

2.3. Research Query

Key words ("smart logistics" OR "smart transportation" OR "smart warehouse" or "smart technologies and logistics") → Subject Area, "Social Science" → Document Type, "Article" → Language, "English" → Publication stage, "Final"

2.4. Research Query Output of Scopus Data Base

Your query: (TITLE-ABS-KEY("smart logistics" OR "smart transportation" OR "smart warehouse" or "smart technologies And logistics")) AND (LIMIT-TO (SUBJAREA,"SOCI")) AND (LIMIT-TO

(DOCTYPE,"ar")) AND (LIMIT-TO (LANGUAGE,"English")) AND (LIMIT-TO (PUBSTAGE,"final")) (Copied from Scopus Output file). To create a bibliometric analysis bases, a full counting method is utilized as shown in figure 2.

3. Data Analysis and Key Results

3.1. Trend Analysis of Publication

Trend analysis is conducted by using R-package (R and R Studio) and biblioshiny. Trend analysis is basically used to analyze the publications over the year along with their relevant sources. The investigation of smart logistics commenced in 1998 with the publication of a single article, marking the initiation of research in this domain. However, progress in this area remained sporadic until 2018, with limited numbers of published articles. Subsequently, a notable upsurge in research activity occurred in 2019, and this growth was further accelerated during the COVID-19 pandemic. Figure 3 illustrates the trajectory of annual progress in smart logistics research. As depicted, a remarkable increase in publications can be observed after 2019, signifying a turning point in the advancement of the field.

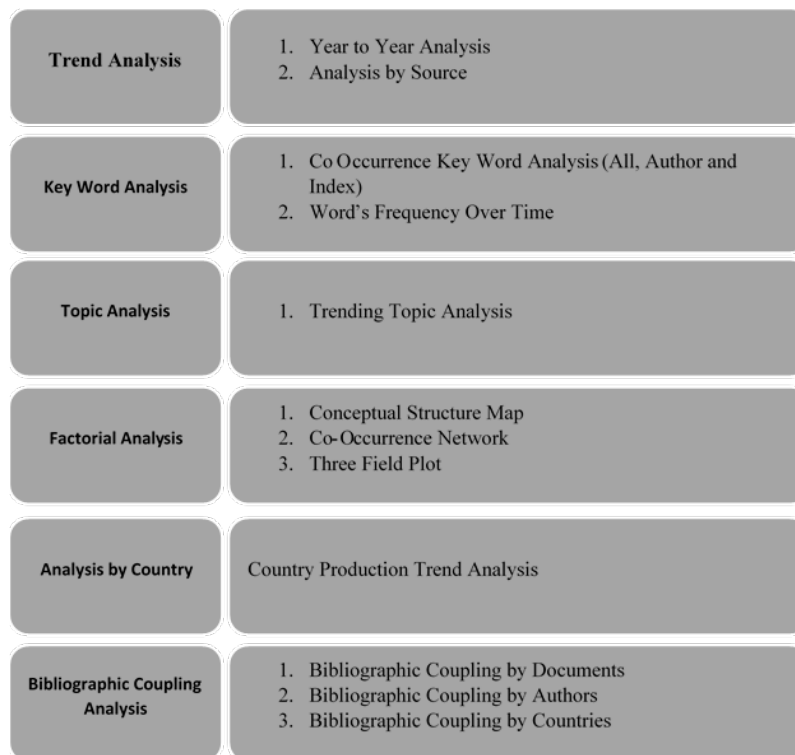


Fig. 2: Research Design

The outbreak of the COVID-19 pandemic in 2019 appears to have played a crucial role in fostering interest and research output in smart logistics

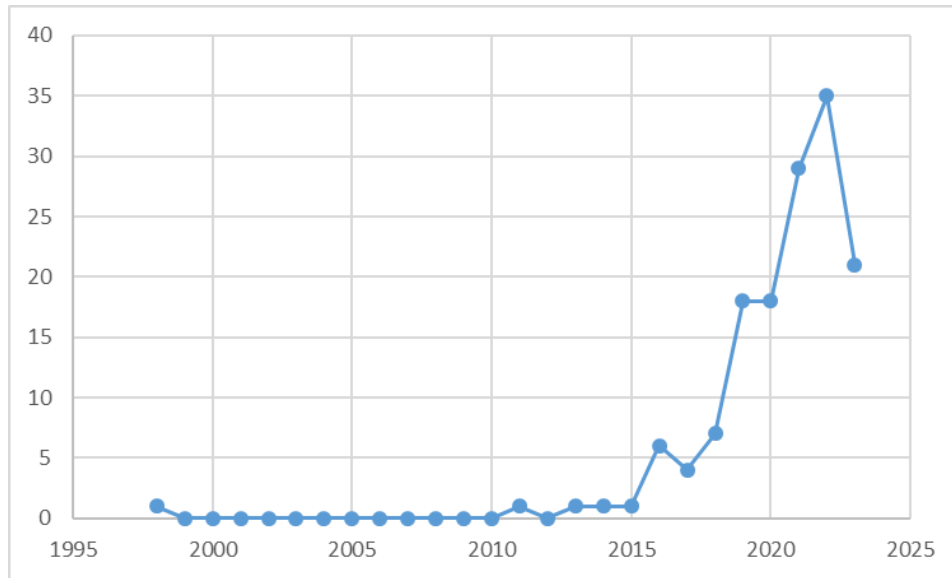


Fig. 3: Publication Trend Analysis.

A total of 66 journals have contributed to smart logistics research dissemination. Among these, the ten most prominent journals are shown in figure 4, with their corresponding percentages of contributions, are as follows; Sustainability Switzerland (36 Articles, 25%), Contemporary Readings In Law And Social Justice (10 Articles, 7%), Sustainable Cities And Society (9 Articles, 6%), Transportation Research Part C: Emerging Technologies (5 Articles, 3%), Advances In Transportation Studies (4 Articles, 3%), Acta Logistica (3 Articles, 2%), Advanced Science Letters (3 Articles, 2%), IET Intelligent Transport Systems (3 Articles, 2%), International Journal Of Supply And Operations Management (3 Articles, 2%), And ISPRS International Journal Of Geo-Information (3 Articles, 2%). This trending analysis indicates that the post-COVID-19 era produces more articles in the area of supply chain management sustainability to manage disruptions in the supply chain of products and products in smart ways supported by technologies.

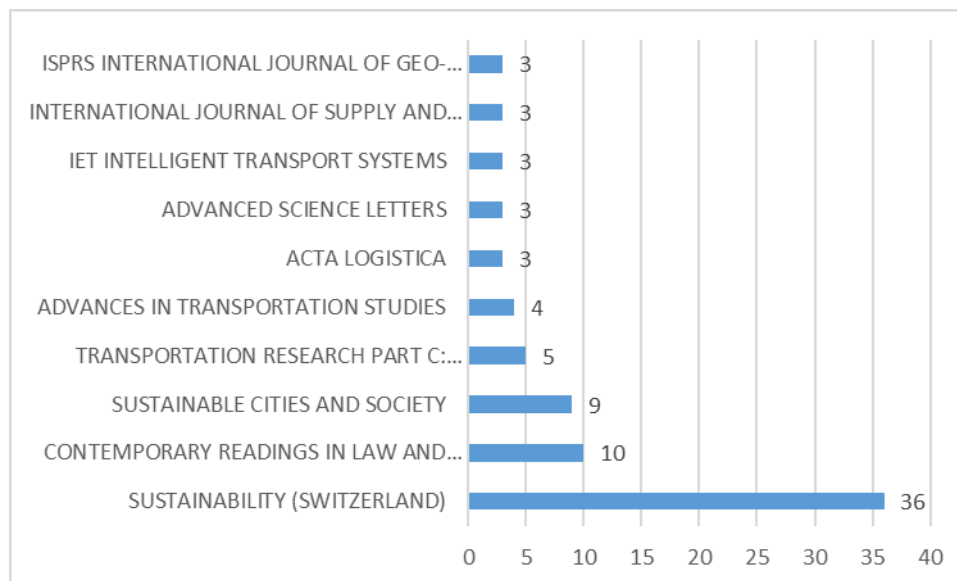


Fig. 4: Most Relevant Sources

3.2. Key and Co-Word Analysis

Co-word analysis is a method used by business scholars to analyze publication content using frequently occurring words, despite potential drawbacks like multiple contexts and general words (Donthu et al., 2021a). Key and co-word analysis is conducted by using both biblioshiny and VOS viewer. The results of VOS viewer are added to analyze the total link strengths as this is the best tool to analyze the co-citation and link strengths (Oladinrin et al., 2023; Shah et al., 2019)

3.2.1. Co-Occurrence Analysis of All Keyword

To analyze and classify the evolving themes and innovative research frontiers in the field of smart logistics over time, we employed keyword co-occurrence analysis. Notably, the frequency of appearance of keywords in publications was considered, and their co-occurrence was used to illustrate their significance. Figure 5, provides the details of co-occurrence analysis of key words by using VOS Viewer. Additionally, we utilized software R to generate Figure 6, which represents a word cloud, and Figure 7, which illustrates a word treemap. In the word treemap, words with higher frequency occupy larger areas in the grid, while those with lower frequency are depicted in smaller sections. The sudden growth in keyword usage points to emerging research trends, and the size of nodes indicates major topics in smart logistics research during different periods. Noteworthy among the recently evolving high-frequency keywords are Smart Cities, Sustainability, Transportation Systems, Logistics, Sustainable Development, Internet of Things, Electronic Commerce, Communication, Transportations, Forecasting, Intelligent Systems, Real-Time Systems, Technology Adoption, and Data Management.

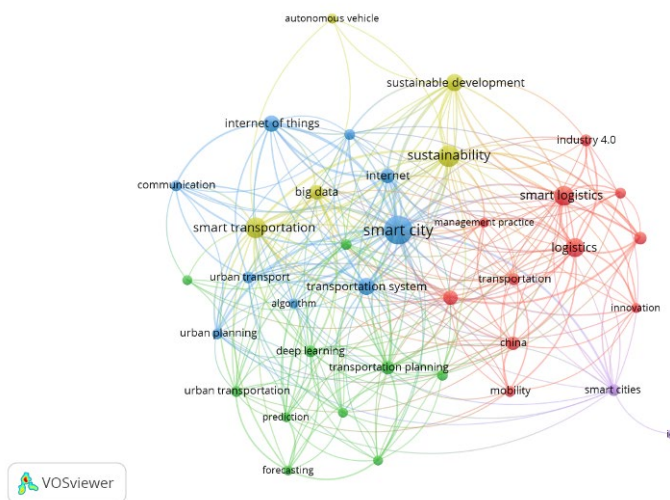


Fig.5: Co-Occurrence of All Key Words



Fig. 6: Word Cloud of All Key Words

The use of multiple keywords by researchers necessitates a vital analysis method to find interesting research areas and determine gaps in the discourse on smart logistics research. To this end, the Treemap analysis plays a crucial role. Figure 7, a Treemap representation, visually presents the notable keywords used in smart logistics research articles. The Treemap shows how data sets are arranged hierarchically, with words naturally clustered into different layers that are connected to studies on smart logistics. The tree map's color scheme, dimension and size depict the keywords' relevance and relationship to one another. Through this analysis, the Treemap highlights the consolidation of keywords that are significant in the context of smart logistics. These consolidated keywords serve as indicators of key research directions and potential new frontiers in smart logistics research. Through the utilization of the VOS viewer, a comprehensive examination of word occurrences and their associated link strengths has been conducted, revealing a ranking of notable terms in table 3.1. Topping this list are Smart Cities exhibiting a remarkable total link strength of 99, followed by Sustainability at 54, Smart transportation at 51, Transportation Systems at 47, Logistics at 46, Sustainable development registering a total link strength of 40, Smart Logistics boasting a total link strength of 39, Transportation Planning with a total link strength of 36, Internet holding a total link strength of 35, and Big Data concluding the list with a total link strength of 32. These results signify the prominence and connectivity of the respective terms within the analyzed context.



Fig.7: Treemap of All Key Words

Through the utilization of the VOS viewer, a comprehensive examination of word occurrences and their associated link strengths has been conducted, revealing a ranking of notable terms in table 1. Topping this list are Smart Cities exhibiting a remarkable total link strength of 99, followed by Sustainability at 54, Smart transportation at 51, Transportation Systems at 47, Logistics at 46, Sustainable development registering a total link strength of 40, Smart Logistics boasting a total link strength of 39, Transportation Planning with a total link strength of 36, Internet holding a total link strength of 35, and Big Data concluding the list with a total link strength of 32. These results signify the prominence and connectivity of the respective terms within the analyzed context.

3.2.2. Co-Occurrence Analysis of Author's Keyword

The exploration of author's keyword co-occurrence is conducted through the utilization of VOS Viewer, as depicted in Figure 8. Within the visual, the interrelation of these keywords is vividly presented. The comprehensive linkage potency of these pivotal terms is exemplified in Table 2. At the pinnacle of this roster, smart transportation emerges as the foremost, boasting a remarkable link strength totaling 15. Pursuing closely is the concept of smart city, displaying a linkage strength of 14, while big data follows suit with a commendable linkage strength of 13.

Additional keywords exhibiting significant linkage potency encompass deep learning (12), smart logistics (9), smart cities (8), and the fourth industrial revolution (6), internet of things (6), machine learning (6), sustainability (6), autonomous vehicles (2), and IOT (1).

Table 1: Co-Occurrence of All Key Words

Keyword	Occurrences	Total link strength
Smart city	38	99
Sustainability	22	54
Smart transportation	20	51
Transportation system	14	47
Logistics	17	46
Sustainable development	14	40
Smart logistics	18	39
Transportation planning	9	36
Internet	10	35
Big data	10	32
Internet of things	12	32
Decision making	10	30
Deep learning	7	27
Urban transport	7	27
China	9	24
Urban planning	6	24
Supply chain management	8	22
Management practice	5	21
Smart cities	7	21
United states	6	19
Communication	6	18
Prediction	5	18
Transportation development	5	18
Travel behavior	5	18
Urban transportation	6	18
Algorithm	5	17
Machine learning	6	17
Numerical model	6	17
Forecasting	5	15
Mobility	6	15
Transportation	7	15

Innovation	5	14
Industry 4.0	7	13
Electronic commerce	6	11
Autonomous vehicles	5	7
Autonomous vehicle	5	4

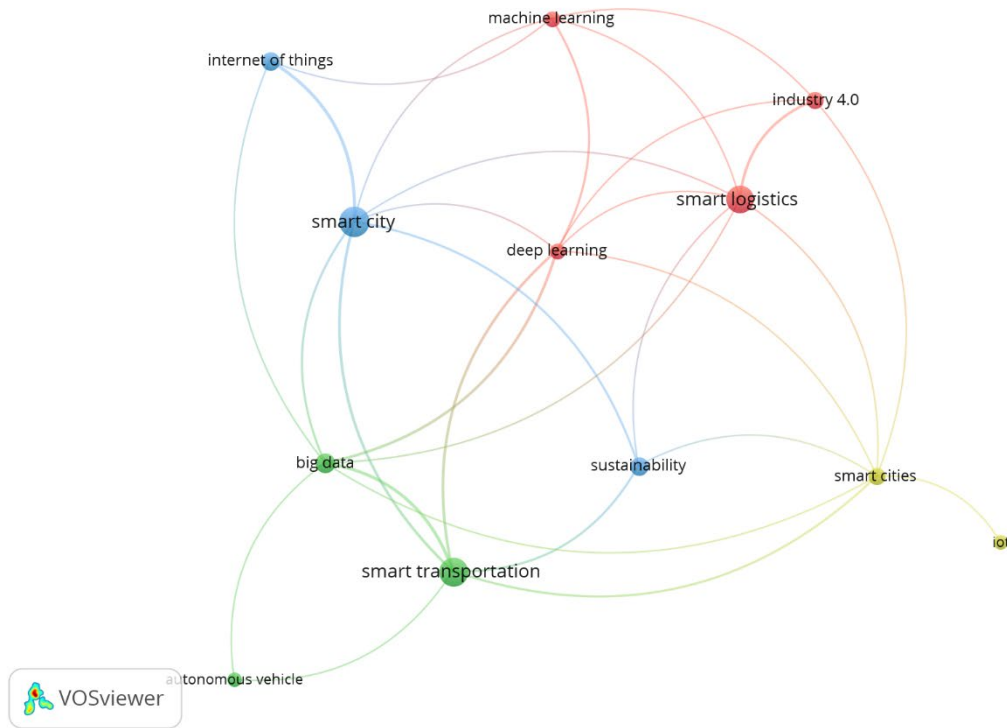


Fig. 8: Co-Occurrence of Author's Keywords

Table 2: Co-Occurrence of Author's Key Words

Keyword	Occurrences	Total Link Strength
Smart Transportation	20	15
Smart City	23	14
Big Data	10	13
Deep Learning	6	12
Smart Logistics	18	9
Smart Cities	7	8
Industry 4.0	7	6
Internet Of Things	8	6
Machine Learning	6	6
Sustainability	8	6
Autonomous Vehicle	5	2
IOT	5	1

3.2.3. Co-Occurrence Analysis of Index Keyword

The investigation into the co-occurrence of keywords within the index is carried out using the VOS Viewer tool, as illustrated in Figure 9. In this visual representation, the intricate connections among these terms are strikingly unveiled. Standing prominently a top this list is the domain of smart city, asserting its prominence. Trailing closely are the notions of transportation system, sustainability, transportation planning, and supply chain management.

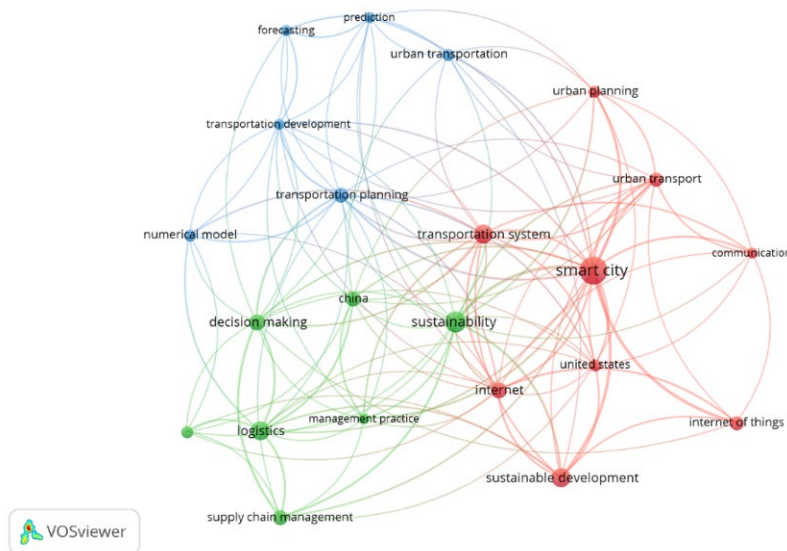


Fig. 9: Co-Occurrence of Index Key Words

Nevertheless, turning our attention to table 3, it becomes evident that the forefront is occupied by the concept of smart city, boasting an total link strength of 62. Following in its wake is sustainability, displaying a cumulative link potency of 34. Transportation systems closely trails behind, amassing a total linked strength of 27, with the internet not far behind at a combined link strength of 25. Co-occurrence of all , author's and indexed key words shows that smart logistics, smart cities by using smart logistics and sustainability have string linked strength among each other and in the context of supply chain management, these technologies based logistics function are at evolving stage.

3.3. Words Frequency over Time

The Figure 10 highlights noteworthy keywords experiencing a marked upsurge, signifying potential areas of research focus in the domain of smart logistics. This visualization illustrates that the knowledge domain unfolds as a sequence of topics, which attain prominence during specific periods and subsequently diminish or vanish. In light of the graph, it becomes evident that domains such as smart city, logistics, internet, supply chain management, sustainability, sustainable development, transport system, and transport planning represent noteworthy research fronts or hotspots in the context of smart logistics research. These areas have garnered considerable attention and are likely to be the subject of extensive investigation and scholarly interest within the field of smart logistics.

3.4. Trending Topics Analysis

Trending topic analysis is a method used by business scholars to analyze trending topics. Trending topic analysis is conducted by using R Studio biblioshiny. This study presents an analysis of the prevailing trends from 2019 to 2023, focusing on the evolution of the Smart Logistics theme over this time span, as depicted in figure 11. Between 2019 and 2020, the concept of smart logistics was closely intertwined with dominant themes, including Supply Chain Management, Urban Planning, and Transportation

System. Concurrently, another pertinent aspect, namely the integration of Smart City and health Transportation System with Smart Logistics, gained prominence.

Table 3: Co-Occurrence of Index Key Words

Keyword	Occurrences	Total Link Strength
Smart City	28	62
Sustainability	16	34
Transportation System	14	27
Internet	10	26
Sustainable Development	13	25
Transportation Planning	9	25
Decision Making	10	23
Logistics	14	22
Urban Transport	7	21
Supply Chain Management	8	16
Transportation Development	5	16
United States	6	16
China	9	15
Internet Of Things	7	15
Management Practice	5	15
Urban Planning	6	15
Communication	5	12
Numerical Model	6	11
Prediction	5	11
Urban Transportation	6	11
Electronic Commerce	6	9
Forecasting	5	9

However, the subsequent period from 2021 to 2023 witnessed a notable diversification of themes associated with Smart Logistics. Recent attention has been notably directed towards novel topics and themes, aligning with Smart Logistics, such as Numerical Model, Logistics, Sustainable Development, Sustainability, and technology-driven logistics. These emerging areas have attracted considerable interest, signifying their significance and relevance within the context of Smart Logistics during the specified period.

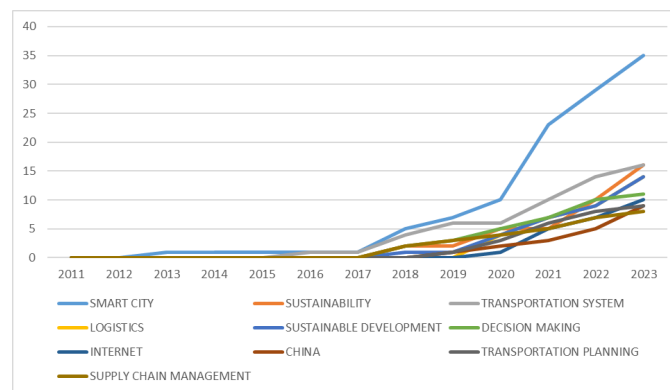


Fig.10: Words Frequency Trend

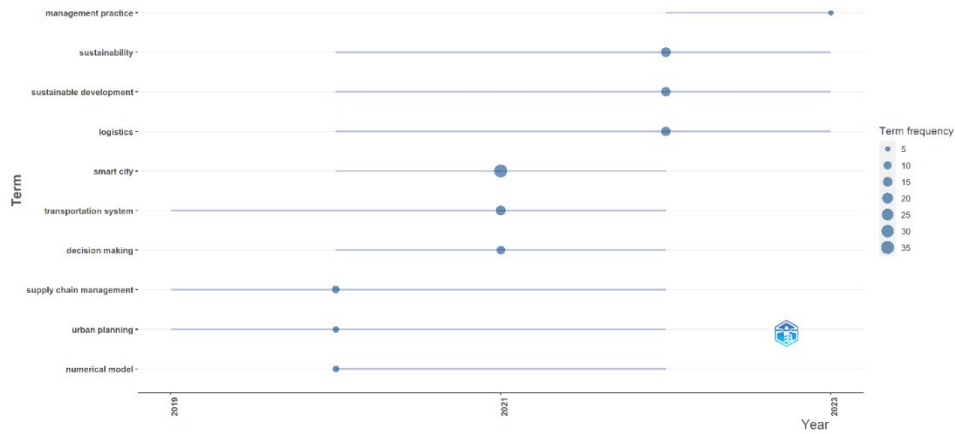


Fig.11: Trending Topics

3.5. Factorial Analysis and Co-occurrence Map

The framework's conceptual structure was depicted through the application of word co-occurrence by using both biblioshiny and VOS viewer to analyze the co-occurrence and total link strength. A multiple correspondence analysis (MCA) outlined by (Malczewski) in 2018. Figure 12 illustrates the conceptual structure map pertaining to smart logistics research over a span of 20 years. The derived conceptual structure map serves to categorize the smart logistics research into distinct main clusters. It is notable that a relatively limited number of researchers has investigated the topics encompassed within this cluster. The aggregation of words into clusters was performed based on their coherence, aiming to group together notions that share common characteristics or themes. The efficacy of the conceptual structure diagram, representing the bibliographical data framework, is effectively demonstrated by the degree of similarity and proximity in the distribution of keywords within the map.

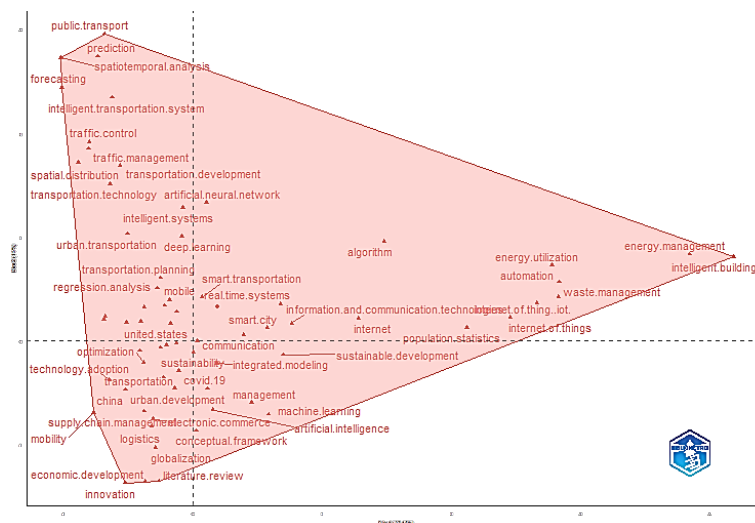


Fig.12: Conceptual Structure Map

The clusters not only provide valuable insights into the organization of knowledge in the field of smart logistics but also highlight areas of research where further exploration and investigation are warranted. From 1998 to 2010, the prevalence of dominant keywords is notably minimal. However, a notable shift in keywords is observed during the subsequent period from 2011 to 2018, with emphasis on terms such as smart city, sustainability, transportation system, sustainable development, and decision-making. A substantial transformation is evident during the period from 2019 to 2023, as a different set of keywords takes precedence, including Logistics, Internet of Things, Big Data, Technology, Transportation

Networks, Planning, and Supply Chain Management.

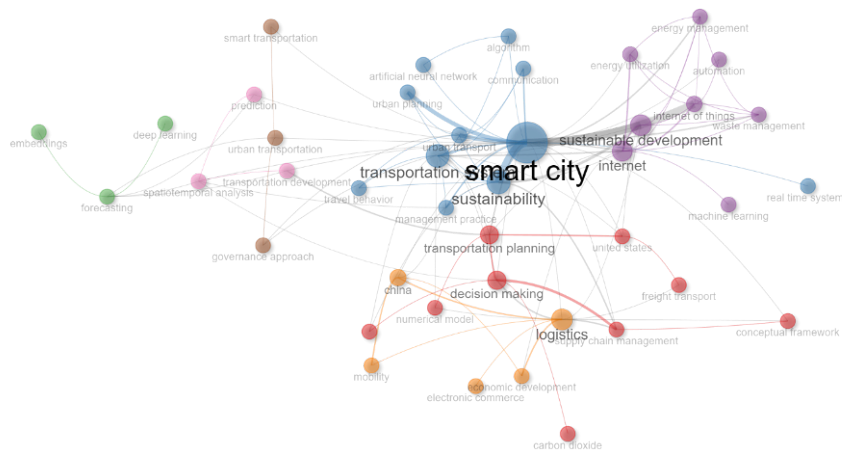


Fig.13: Co-Occurrence Network

These shifting patterns illustrate the dynamic nature of smart logistics research across the specified time spans. Remarkably, the analysis reveals that the smart logistics cluster persistently dominates throughout all three periods, emphasizing its enduring significance within the field of study.

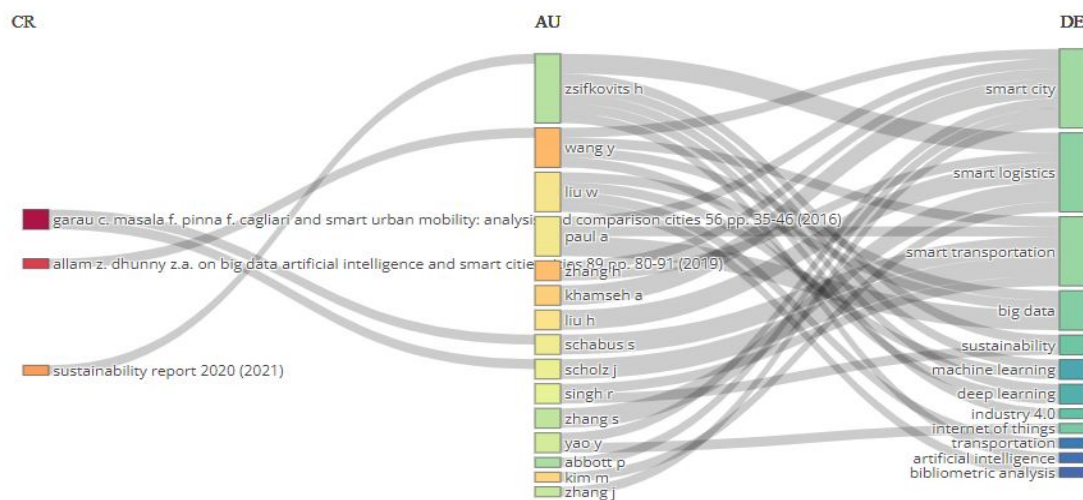


Fig. 14: Three-Field Plot

This observation highlights the enduring relevance and importance of the smart logistics cluster across various time intervals. In recent times, research efforts in the domain of smart logistics have notably intensified, encompassing developments that emanate from traditional logistics and transportation systems. To assess the interrelations between the left side which is source, in the middle which are keywords, and right side which are countries, we employed a three field plot, commonly known as the Sankey diagram in figure 14. This visualization effectively illustrates the flow trends among various entities. Within the three-field plot, the sizes of the boxes and arrow widths are directly proportional to the corresponding numbers and quantities. The thematic representation in the plot is designated based on the keyword with the highest degree. As depicted in figure 14, the edges originating from keywords such as Smart Logistics, Smart City, Smart Transportation, Big Data, and Sustainability exhibit the greatest width, indicating that these keywords are recurrently employed in publications by numerous journals, authors, and countries.

Furthermore, specific sources, exemplified by the Sustainability Report, display a relatively higher frequency of utilizing keywords related to Smart Logistics as compared to other sources. This observation implies that within the realm of Sustainability, diverse themes are encompassed and explored by these sources. The three-field plot serves as an insightful tool for understanding the patterns of keyword usage, providing valuable perspectives on the research landscape within the smart logistics domain and its interaction with related themes and sources.

3.6. Analysis by Countries

The analysis of countries' production and demand over the year is performed using R Studio biblioshiny and VOS viewer software packages for coupling analysis.

3.6.1. Country Production Trend Analysis

China stands as the most prolific country in the domain of Smart Logistics research, having published a total of 323 articles during the period spanning from 1998 to 2023. The United States follows closely with 203 articles, while Korea, India, and Slovakia have contributed 176, 134, and 80 articles, respectively, thus significantly advancing the body of literature on smart logistics. The dominance of China and the United States as influential countries in the realm of scientific and social sciences publications is not surprising, given their substantial research contributions.

A notable expansion is evident when comparing the historical perspective of research on Logistics and Supply Chain Management. Specifically, during the time frame from 2017 to 2023, Korea and India were the sole countries to publish at least 310 documents on Smart Logistics, signifying a noteworthy surge in their research output within this period.

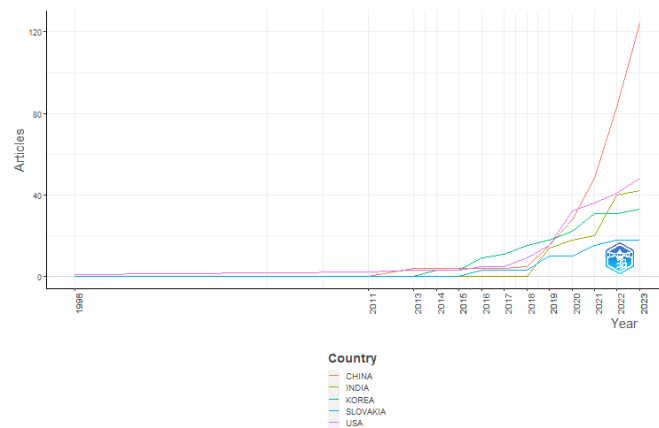


Fig. 15: Country Production Trend Analysis

The international collaboration network is depicted in figure 15. The international network engaged in research on Smart Logistics has significantly intensified, and it is intriguing to observe how countries with the highest publication outputs have established collaborations. The network grid highlights major connections between countries, such as the China, USA and UK. Despite these countries having established significant associations with one another, they have also engaged in notable collaborations with more distantly located countries.

Prominent collaborations are witnessed in figures 16 a and b between the China, Korea, India, Slovakia and USA. Additionally, other collaborations involving various countries are also emerging with evident contributions in the field of Smart Logistics research. These collaborative efforts facilitate the exchange of knowledge and expertise, fostering advancements in the field and addressing challenges in a global

context.

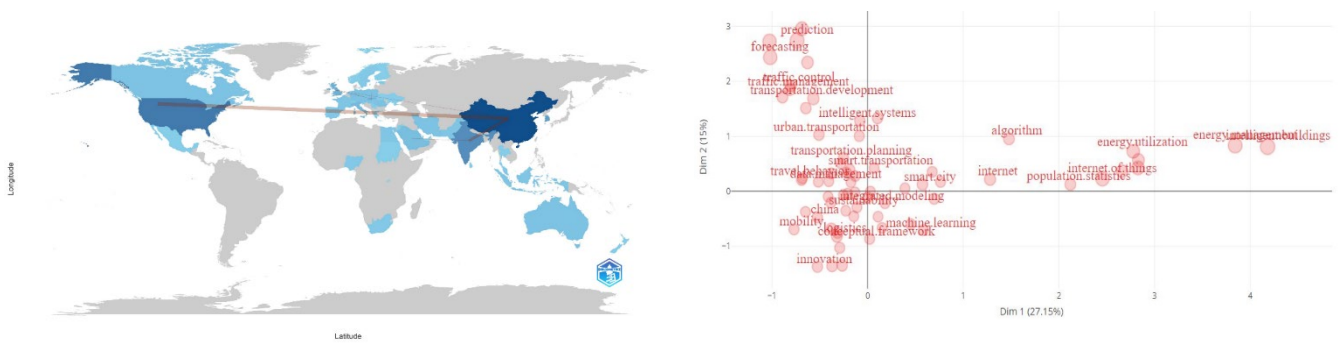


Fig. 16 a & b: Country Collaboration Map

3.7. Bibliographic Coupling Analysis

An alternative approach to bibliographic analysis is undertaken within this research, referred to as bibliographic coupling which is a pure main technique of bibliometric analysis which is called science mapping. This coupling arises when two articles share a common third article in their individual lists of references. With this shared reference in view, it becomes probable that both pieces delve into a subject that holds relevance to one another. The total linked strength explains the frequency of the articles they coincide. This analysis is conducted by using two main software; one is VOS viewer and one is R Studio biblioshiny

3.7.1. Bibliographic Coupling of Documents

In total, we included 143 publications in our research. Our review of these articles aimed to enhance our understanding of how smart logistics contribute to sustainable supply chain management. All 143 documents meet the minimum requirement set by the VOS Viewer for bibliographic coupling. In figure 17 a & b, we present a visual representation of the diverse evolution of smart logistics within the context of supply chain sustainability, spanning from earlier times to the present. The circular shape in the figures signifies significant papers, concepts, and scholars within our study domain. figure 17 a showcase the bibliographic coupling among all documents, while figure 17 b demonstrates the interconnectedness of bibliographic coupling among these works.

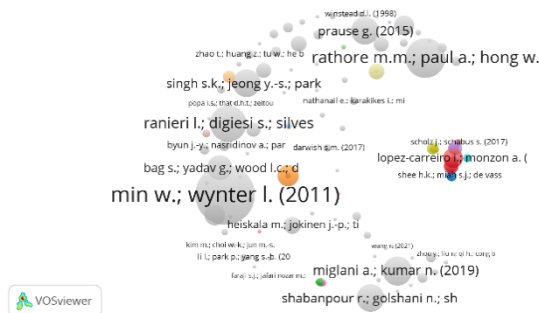


Fig. 17a: Bibliographic Coupling by All

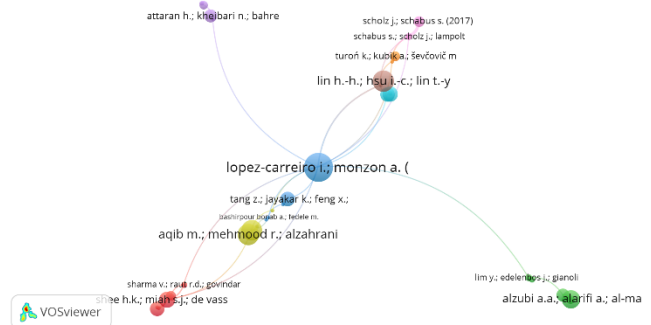


Fig. 17 b: Bibliographic Coupling by Linked

Total linked strength of bibliographic coupled documents shows in table 4. This table shows the top ten

articles which are coupled with highest total strength with each other. These includes Peters, (2022) with total strength 22, Aldridge & Stehel, (2021) with total strength 22, Tomas et al., (2022) with total strength 21, Elizabeth & Pavol, (2021) with total strength 19, B. Elizabeth & Aurel, (2021) with total strength 19, Edward, (2021) with total strength 15, Raluca-Ştefania & Adela-Claudia, (2022) with total strength 14, Linda & Natalia, (2021) with total strength 13, Schabus et al., (2017) with total strength 13, and Lopez-Carreiro & Monzon, (2018) with total strength 12.

Table 4: Top Ten Bibliographic Coupled Documents by Total Link Strength

Document	Citations	Total Link Strength
Peters E. (2022)	1	27
Aldridge S.; Stehel V. (2021)	5	22
Kliestik T.; Musa H.; Machova V.; Rice L. (2022)	9	21
Clayton E.; Kral P. (2021)	7	19
Blackburn E.; Pera A. (2021)	3	19
Taylor E. (2021)	8	15
Balica R.-Ş.; Cuţitoi A.-C. (2022)	1	14
Green L.; Zhuravleva N.A. (2021)	8	13
Schabus S.; Scholz J.; Lampoltshammer T.J. (2017)	4	13
Lopez-Carreiro I.; Monzon A. (2018)	62	12

3.7.2. Bibliographic Coupling of Authors

During the bibliographic coupling analysis of scholars within the domain of smart logistics, our examination encompassed a corpus of 14,307 affiliated authors across 143 publications spanning the period from 1998 to the present. Our criteria stipulated that an author must be associated with at least one publication, each of which garnered a minimum of five citations. The tabulated results in Table 5 offer insight into the foremost contributors, elucidating their article count, reference frequency, and associated link strengths. Particularly noteworthy are Aldridge S., Stehel V., and Taylor E., who emerge as the most prominent authors with 11 and 10 cumulative linked strengths, respectively. In a similar vein, Clayton E. and Kral P. rank as the third most salient authors, boasting a combined linked strength of 8. It is of pertinence to highlight that these eminent scholars also command the highest aggregate link strength values.

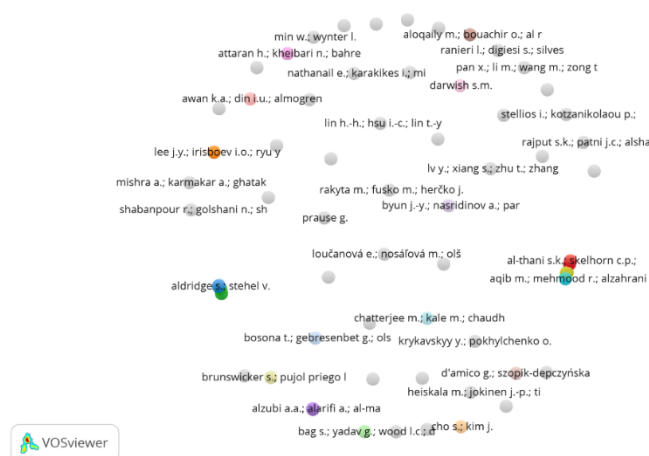


Fig. 18: Bibliographic Coupling of Authors

Table 5: Top Ten Authors of Bibliographic Coupling

Author	Documents	Citations	Total Link Strength
Aldridge S.; Stehel V.	1	5	11
Taylor E.	1	8	10
Clayton E.; Kral P.	1	7	8
Green L.; Zhuravleva N.A.	1	8	7
Kliestik T.; Musa H.; Machova V.; Rice L.	1	9	6
Nelson A.	1	9	6
Shee H.K.; Miah S.J.; De Vass T.	1	19	5
Sheares G.	1	5	4
Herath H.M.K.K.M.B.; Mittal M.	1	30	3

3.7.3. Bibliographic Coupling of Countries

China stands out as the foremost prolific nation, contributing a total of 34 scholarly articles to the discourse on smart logistics between the years 1998 and 2023. Following China, the United States produced 24 papers, while India contributed 18, the United Kingdom presented 9, South Korea offered 13, Slovakia contributed 8, Saudi Arabia submitted 5, and Italy furnished 6 publications. Such meticulous consideration towards the cumulative linked strength underscores the significance of these contributions within the smart logistics research domain. The preeminence of China as the paramount influencer in research publications is a result that comes as no surprise.

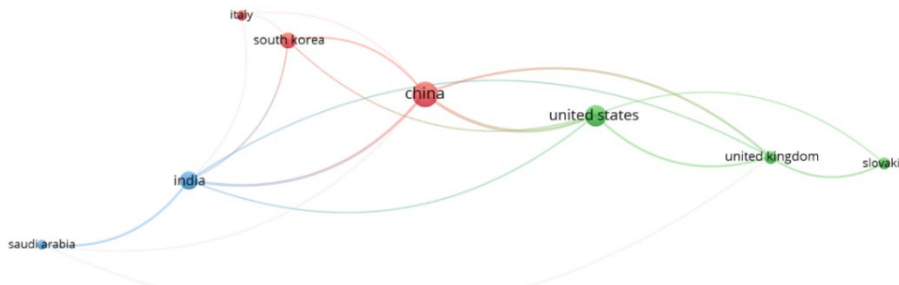


Fig. 19: Bibliographic Coupling of Countries

Table 6: Bibliographic Coupled Countries

Country	Documents	Citations	Total Link Strength
China	34	350	516
United States	24	812	385
India	18	354	381
United Kingdom	9	51	318
South Korea	13	437	142
Slovakia	8	68	106
Saudi Arabia	5	72	97
Italy	6	318	5

4. Discussion

This study provides a comprehensive bibliometric analysis of Smart Logistics for Sustainability in Supply Chain Management. It identifies trends analysis year to year as well as the most pertinent sources. Results shows that post COVID-19 era is the main era in which companies felt the need of smart logistics for their supply chain management sustainability and suitability is the most prominent source is reported who published maximum papers of smart logistics. This research also reported the key word analysis in different forms like co-occurrence of all key words, author's key words and indexed keywords and output of this analysis shows that smart logistics, smart cities with smart transportation and sustainability are among the top and the total linked strength of these words are the highest one. So, this review analysis provides a comprehensive database to the researchers.

The analysis also highlights the integration of cutting-edge technologies and sustainability principles. The insights inform researchers, practitioners, and policymakers, facilitating collaboration and guiding future advancements in this critical field. The research pertaining to smart logistics continues to intrude into various academic disciplines and many countries, establishing firm foundations (Li et al., 2023). The increase of essentials of smart logistics principles within sustainable supply chain management highlights importance to enhance its operational usage for organizations (D'Amico et al., 2021).

From an academic and applied perspective, this study serves as a guiding model for scholars in the domains of logistics and supply chain management, unveiling the underlying dynamics through the model. Through the utilization of bibliometric analysis in combination with coupling analysis, this research has effectively described preeminent authors, prolific journals, important institutions, and significant countries, all while visualizing and tracking the evolutionary trajectory of the field. The realm of smart logistics exhibits escalating diversification, and the outcomes of this study yield significant implications for the comprehensive evaluation of sustainability research. Our meticulous data collection and retrieval process have yielded valuable insights, thus furnishing a substantial contribution to the body of knowledge.

5. Conclusion

This bibliometric analysis offers valuable insights into the emerging structure and trajectory of smart logistics research, revealing rising publications and key focus areas like sustainability and transportation. However, constraints exist regarding the Scopus database reliance and the limited accumulated literature. As smart logistics investigations continue to proliferate, future bibliometric studies can incorporate co-citation analysis and additional databases to provide enhanced perspectives. With technological proliferation, understanding the knowledge domain evolution through quantitative bibliometric assessments will remain crucial. This study contributes meaningful base indicators, while highlighting opportunities for deeper analytic approaches as publications accumulate. The enrichment techniques of bibliometric analysis as mentioned by (Donthu et al) in 2021 are not used in this paper. Future researchers may conduct a bibliometric analysis by using these enrichment techniques. Furthermore, the findings can inform researchers on key contributors, topics, and collaborations, guiding future scholarship. Regular bibliometric monitoring of this developing domain can yield updated insights to track the research progression.

6. Limitations and Future Research Direction of the Study

Nevertheless, it is prudent to acknowledge certain limitations inherent in our approach. First, it is important to note that our focus in this study was not exclusively centered upon the examination of social ties among co-authors and co-cited authors. To enhance the comprehensive comprehension of intellectual progression, shared collaborative experiences, as well as the social interconnections among

authors and their collaborative networks, subsequent investigations could be undertaken to augment the extant body of knowledge within the realm of smart logistics. Secondly, within the delimited subset derived from the Scopus database, our inquiry delved into primary structural attributes, bibliometric coupling, and conceptual mappings. Employing the Scopus database, renowned for its expansive coverage, served as the principal foundation in this type of scholarly endeavor. However, it is imperative to acknowledge that an exclusive reliance on the Scopus database might constrict the categorization of publications within broader academic domains. In this context, the incorporation of broader-ranging databases such as WoS and Google Scholar could be considered for forthcoming research ventures. This strategic integration would facilitate a more comprehensive exploration of the field. Thirdly, we didn't do Co-Citation analysis in this study. This is because of two reasons: First, we had limitations in the data we could use. Second, the idea of "Smart Logistics" is relatively new, and many researchers are studying it. This paper will catch the attention of various experts and regions, and they're using different methods to add to what we know. So, in the future, we might include Co-Citation analysis to our study after some new publications. Last but not least, The enrichment techniques of bibliometric analysis as mentioned by (Donthu et al) in 2021 are not used in this paper. Future researchers may conduct a bibliometric analysis by using these enrichment techniques.

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