Mapping the Research Landscape of Supply Chain Management and Machine Learning: A Bibliometric Analysis

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Abstract:
This study uses a bibliometric analysis of papers included in the Web of Science database from 2000 to 2025 to investigate the development of research at the nexus of supply chain management (SCM) and machine learning (ML). In order to comprehend the intellectual framework of this field of study, the study looks into publishing trends, significant authors, collaboration networks, citation patterns, and topic advancements. To find significant contributions, well-established research themes, and new research directions, bibliometric approaches such as citation analysis, co-citation analysis, and keyword co-occurrence analysis are used. The results show that there is growing interest among academics in applying machine learning to supply chain management, especially in the areas of supply chain resilience, demand forecasting, operational optimization, and predictive analytics. Additionally, the analysis pinpoints new lines of inquiry concerning data-driven supply chain decision-making, blockchain integration, and sustainability. The study admits limitations related to the sole use of the Web of Science database and the lack of qualitative content analysis, notwithstanding its contributions.In order to tackle difficult supply chain problems, future research may examine interdisciplinary approaches, methodological developments, and new machine learning applications. All things considered, this paper offers a thorough summary of the theoretical underpinnings, advancements, and potential future paths of supply chain management machine learning research.

Keywords: Supply Chain Management; Machine Learning; Bibliometric Analysis; Supply Chain Analytics; Supply Chain Resilience.

1.Introduction

The application of machine learning (ML) techniques in supply chain management (SCM) has revolutionized how companies set up, oversee, and improve their supply chain operations in recent years. Globalization, quick technical advancements, and changing consumer expectations have made traditional supply chain management's problems such as demand forecasting, inventory control, transportation optimization, supplier selection, and risk reduction more difficult. Machine learning has offered previously unheard-of answers to these issues by processing and analyzing enormous amounts of data in real time.Overall, by revealing hidden patterns, offering predictive insights, and automating decision-making procedures, machine learning has helped companies create supply chains that are more effective, robust, and flexible in the age of uncertainty.
The application of ML-inspired SCM solutions is more important than ever. Agility and data-driven decision-making are more important than ever in a time of global uncertainty, which includes increased problems including trade disruptions, pandemics, and geopolitical tensions. In this regard, machine learning can assist companies in improving supply chain performance, optimizing resource use, and responding quickly to

market dynamics. As a result, the amount of research in this multidisciplinary topic has increased, underscoring the growing significance of the SCM-ML combination in both industry and academia. Bibliometric analysis is a methodical and quantitative assessment of scholarly literature that enables a thorough comprehension of the development of this field of knowledge. Bibliometric research can examine the structure and evolution of scientific research, reveal publication volume patterns, highlight important publications and authors, and reveal collaborative networks.These analyzes are particularly helpful in defining a topic's intellectual space, identifying its drivers, and giving experts, researchers, and decision makers relevant information. A bibliometric method is especially appropriate for the fields of SCM and ML because of the multidisciplinary nature of the issues involved and their quick changes.

One of the best databases for the vast quantity of excellent scientific papers that may be used as the foundation for a bibliometric analysis is the Web of Science database. It gives researchers access to a wide range of journals, conference proceedings, and other academic publications, allowing them to monitor the evolution of SCM-ML themes over time, identify institutional and geographic activity clusters, and measure the impact of publications and individual authors.The goal of this study is to reveal the history of SCM and ML integration over the past 20 years while using Web of Science's bibliometric analysis feature to provide a thorough picture of the research field. A bibliometric study of SCM-ML research conducted between 2000 and 2025 is presented in this paper. It provides a thorough summary of a variety of metrics, including topical indicator areas, authorship, international co-authorship, publishing patterns, and citation impact. The analysis identifies significant turning points in the field's evolution, the most important writers and organizations, and recent findings.The paper provides a comprehensive picture of the development of SCM-ML research, its current state, and its potential future directions through the use of intricate visualizations and analytical insights. This research study's emphasis on the collaborative and multidisciplinary nature of SCM-ML research is a key component. These findings demonstrate how the confluence of skills from various disciplines, including computer science, operations research, industrial engineering, and business management, led to the adoption of machine learning technologies in supply chain management.

This paper contributes to our understanding of the intellectual foundations, emerging trends, and future prospects of SCMML research by providing a sophisticated bibliometric perspective. The resource offers useful insights to industry practitioners trying to apply machine learning to real-world supply chain difficulties, in addition to helping research and academics develop new concepts in the field of SCMML. Additionally, it draws attention to the knowledge gaps and the need for more investigation into the problems of contemporary supply chains, laying the groundwork for a more thorough and all-encompassing strategy to solve the issues of the current supply chain.The importance of machine learning will only increase as supply chain management continues to change due to technological improvements and the problems posed by international marketplaces. The research environment at the intersection of these two cutting-edge domains is presented in this relevant and comprehensive bibliometric analysis. In order to stimulate future research that will impact supply chains in an increasingly connected and data-driven world, this study attempts to increase awareness of trends, significant contributors, and new themes in SCMML research.

Section 2 included a summary of the literature, while Section 3 described the research's parameters and analytical approach. Section 4 discusses and presents the analysis's results, while Section 5 offers recommendations for how this approach may be applied to explore any potential new study topics and gaps in the literature.

2. Literature Review

The effective flow of goods, services, and information from suppliers to customers is guarantyd by supply chain management, or SCM. Organizations' use of technology is making these processes more complex. Among these, Big Data Analytics (BDA) is seen as a game-changer that can improve supply chain (SC) agility,

efficiency, and decision-making (Rozados & Tjahjono, 2014).Maintaining both client loyalty and cost efficiency appears to be a difficulty for retail businesses. Research has shown that best practice methods can be utilized to help overcome such competing demands (Gopal et al., 2022). Inventory management, demand forecasting, and overall performance have all benefited from sophisticated analytics like artificial intelligence (AI) and machine learning (ML) in this context (Souza, 2014; Sodiya et al., 2024).

Furthermore, strategic planning and performance optimization in SCM depend heavily on effective data management (Chae et al., 2013). However, in order to stay competitive and keep clients, it is now more important than ever to improve traditional business intelligence (BI) systems to offer more sophisticated analytics capabilities (Sahay, 2008). But planning analytics are also crucial for improving transparency, especially when it comes to sourcing and downstream manufacturing in unpredictable supply situations (Zhu et al., 2018).

Advanced supply chain analytics capabilities (SCAC) are being created and used more and more since they are now acknowledged as a significant factor in performance improvement. Decisions that consider the chain's needs while simultaneously fostering social and financial advantages can be made by putting into practice a framework based on the SCAC principles (Fosso et al., 2018; Arya et al., 2017). When there is a lot of environmental volatility, the combination of BDA and AI-driven analytics can greatly improve performance and boost resilience and adaptability (Dubey, 2018).Other external elements that impact BDA, specifically its volume and velocity which is crucial in relation to agile supply chains include market instability and rivalry (Cadden et al., 2022). Furthermore, it has been acknowledged that real-time and predictive analytics can improve risk management, speed up response times, and boost agility after disruptions (Aljohani, 2023).

The success of supply chain analytics is also significantly impacted by the parties' relationship. For example, if the relationships are regarded as procedural justice, the company can tailor its tactics to the various relational justice levels, improving the SCM results (Ahmed et al., 2022). Managers must employ BDA to build resilience and adaptability in today's more complicated global supply chains (as is now validated by recent empirical studies: Zamani et al., 2023; Ittmann, 2015).Other technologies that have been employed to enhance the usage of SCM analytics include sentiment analysis, clustering, and nonparametric statistical techniques (Barzizza et al., 2023). Additionally, the application of AI for analytics has spread to a number of sectors, including humanitarian logistics, where AI-powered solutions reduce information overload and improve operational efficiency (Dubey et al., 2022; Brau et al., 2023).Finally, supply chain executives can employ AI and BDA to maximize performance in addition to expanding their operations and lowering risks. The development of these is crucial for the future of SCM research and implementation (Wong et al., 2021; Khedr & Rani, 2024; Mahi, 2024).

2.1 Objectives of Study

1. To examine how research on the use of machine learning (ML) to supply chain management (SCM) has changed over time.
2. Identify key authors, organizations and countries that are significantly contributing to the academic discourse at the intersection of SCM and ML.
3. To apply thematic clustering and keywords co-occurrence analysis for locating research hotspot and dominant themes.
4. To connect the networks of cooperation between authors, organizations and countries in the SCM-ML field**.**

3. Methodology

The intellectual structure and research tendencies of the selected field are examined and evaluated in this study using bibliometric analytic methodologies. The Web of Science database was used to obtain the data

set because it is the greatest collection of high-quality, peer-reviewed literature. The bibliometric techniques used include citation analysis, which determines the most influential publications and authors, co-citation analysis, which determines the connections between publications, and keyword co-occurrence analysis, which finds theme networks and new trends.VOSviewer and Bibliometrix were the tools utilized for data analysis and visualization. Additionally, the primary themes over time were analyzed, and cluster analysis was used to group the study themes and demonstrate the relationships between them. These methods offer a solid framework for understanding the current state of this field's research and can guide current and upcoming studies

In this instance, 998 research publications containing the phrases "Supply Chain Management" AND "Machine Learning" were found through an advanced search of the Web of Science database. The "English" language and the 2000–2025 timeframe were then used to further refine the search results. During these years, 993 scientific publications covering digital marketing issues in the banking industry were produced and added to the Web of Science database.According to this analysis, the Web of Science database has papers on digital marketing in the banking industry that date back to 1993. Research hotspots and future directions are also highlighted. The Biblioshiny tool, developed by Massimo ARIA from the Federico II University of Naples, and VOSviewer were used to perform the bibliometric analysis presented in this article. This Java application combines the usability of a Web application created with the Shiny package environment with the capabilities of the bibliometrix package.

3. Result and analysis

Figure 1 shows the overall bibliometric indicators of supply chain management (SCM) and machine learning (ML) research from 2000 to 2025. Some of the most important publication and collaboration statistics are displayed, including 993 documents published in 382 sources at an astounding annual rate of 12.26%. The 49 contributors to single-authored publications and the 3,510 contributors to the field demonstrate the collaborative character of the subject. With an average of 4.42 co-authors per document, international co-authorship is 38.87%, demonstrating the integration of global research.Additionally, study themes are shown by 3,286 distinct author keywords, and the publication's breadth is demonstrated by the 59,741 references. Each document receives an average of 24.43 citations, indicating its importance and relevancy, and its average age is 3.13 years. This summary concludes by highlighting the robust and collaborative growth of SCM-ML research.



Figure-1: More information about data

In figure 2 the number of scholarly articles pertaining to machine learning (ML) and supply chain management (SCM) has increased over the last 25 years, from 2000 to 2025, as this graph illustrates. Between 2000 and roughly 2015, there was a trend of a comparatively steady publishing rate with just minor variations. However, because of the growing significance and interest in ML applications in SCM, the scientific output begins to rise significantly around 2016. The sharp rise between 2022 and 2023 is indicative of the significant research activities.This decline in 2024–2025 could be the result of either a brief slowdown in production or insufficient data for that time frame. This tendency reflects the growth of this multidisciplinary field of study in academia, particularly in recent years.

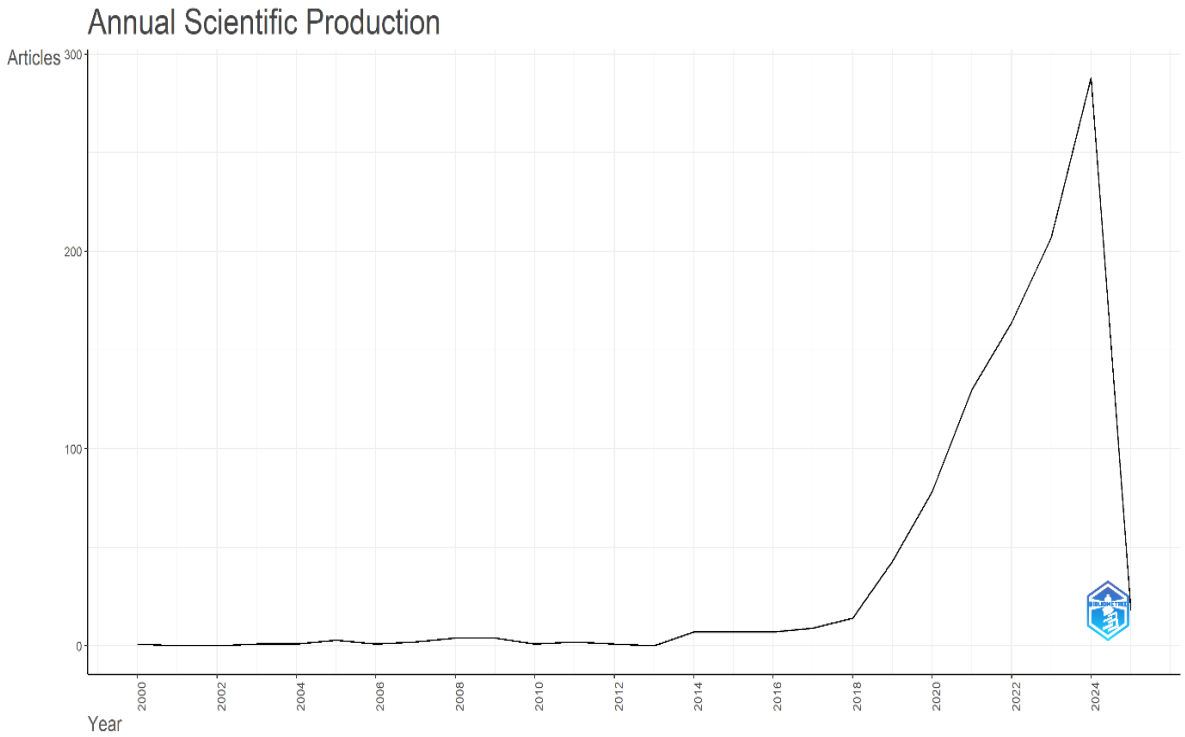

Fig 2: Annual Scientific Production

Figure 3 shows the annual trend of publications mentioned. Citations first increase slowly until about 2016. The average citations from 2017 to 2018/2019 show a distinct rising trend, suggesting that significant works were published during these years. After 2020, the number of citations drastically declines, which could be due to a shift in the journals' focus, a lack of interest, or less significant studies. Relationships between Citation Records (CR), Authors (AU), and Domains/Keywords (DE) are shown in Figure 3.Each of these connections between works (CR) and authors (AU) and between issues (DE) they touch represents the nature of the relationships between them. For example, important phrases like "machine learning," "supply chain management," and "blockchain" reflect the research trend and collaboration network in the relevant domains, and the keywords are linked to individual authors.

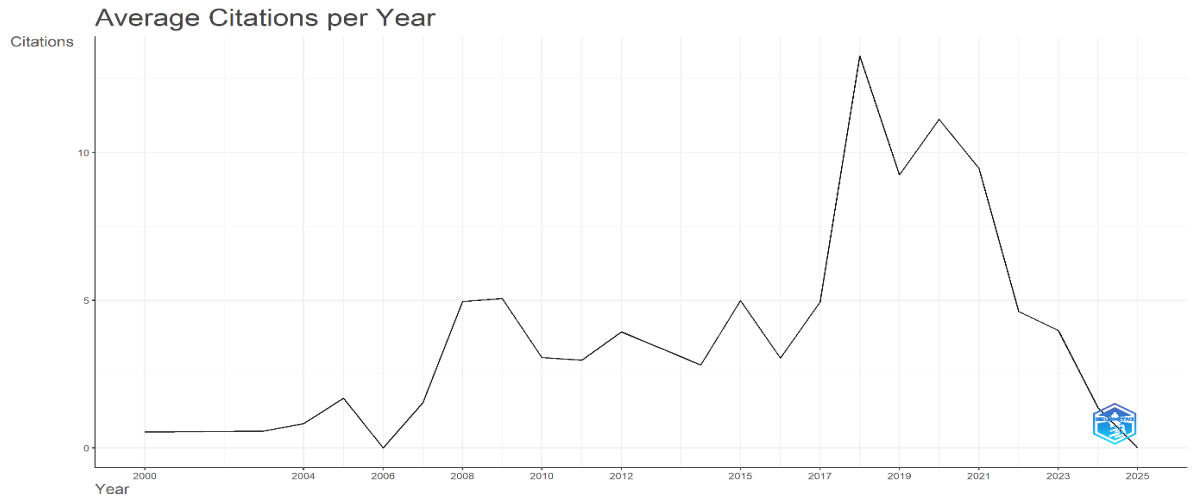

Figure-3: Average Citations per Year

The figure 4 describe relationships between three elements Citation Records (CR), Authors (AU), and Domains/Keywords (DE) are depicted in the diagram. The relationships are between particular works (CR) and authors (AU), as well as between the subjects (DE) covered by each work. For example, the terms "machine learning," "supply chain management," and "blockchain" are frequently associated with specific writers, indicating connections and trends in various fields of study.

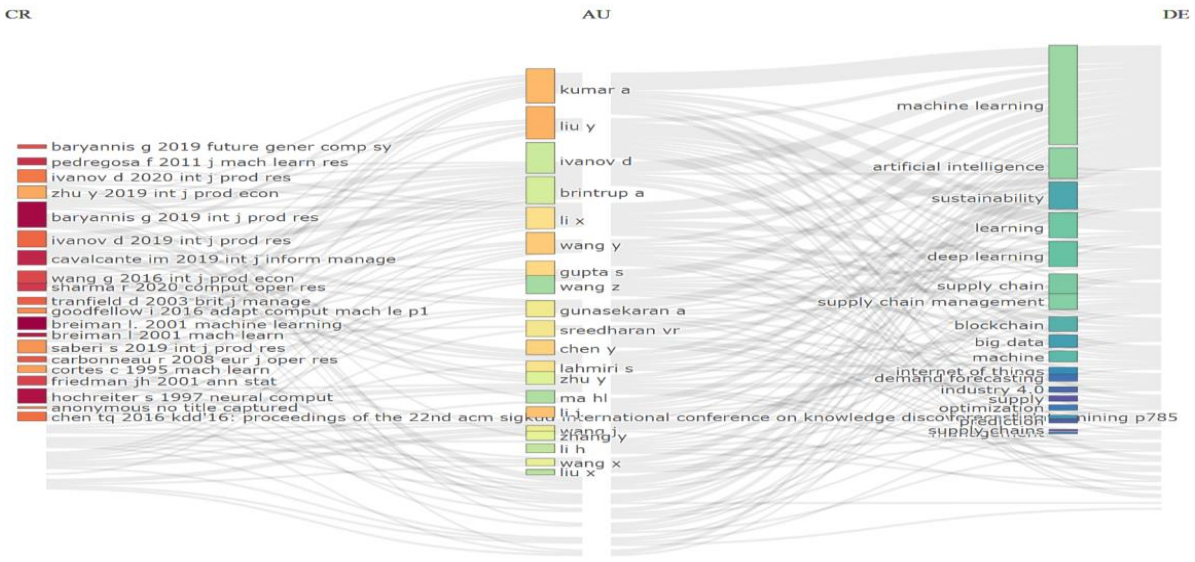

Figure-4: Network Flow Diagram

The size of the bubbles in this figure 5 indicates the subjects that have been popular over time. The terms "performance," "supply chain," and "decision-support system" have become increasingly prevalent in recent years (2021–2023). The horizontal lines indicate a term's years of relevance, or the years it was applicable. The frequency increased with the size of the bubbles, indicating that they were important areas of study at the time.

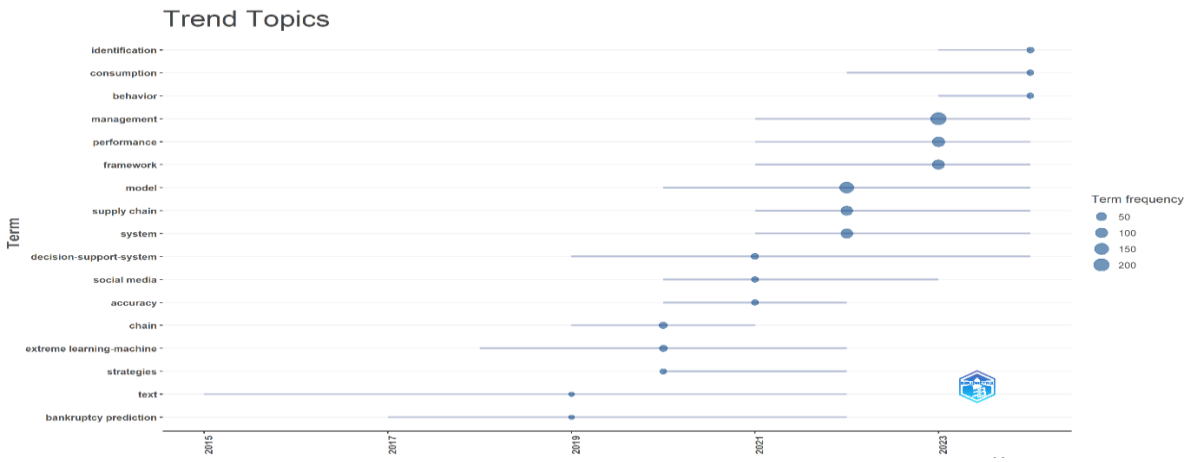

Figure-5: Trend Topics

This graph displays in figure 6 how frequently terms like "design," "management," and "system" have been used over time. Most of these terms are mentioned extremely infrequently before 2015, rapidly increase around 2017, and then pick up speed after 2020, indicating a recent surge in interest in these topics. In 2023, the most commonly used phrases, such "management" and "performance," predominate, indicating their crucial importance in continuing research.

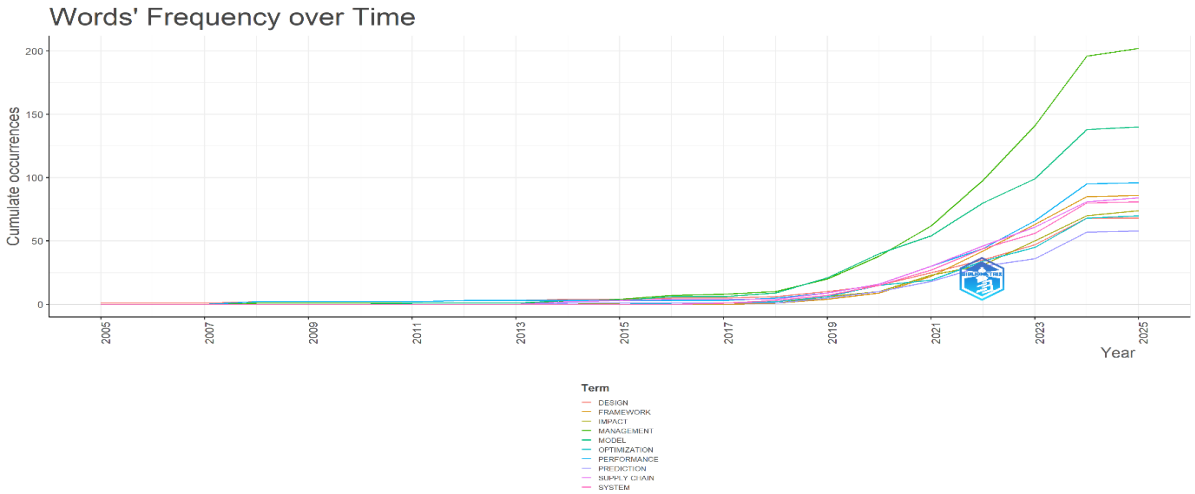

Figure-6: Word Frequency Growth over Time

The distribution of important phrases based on their frequency in research is shown in this tree map. The most important subjects, such as "management," "model," and "performance," have the biggest blocks. Other, less revolutionary subjects include "framework," "supply chain," and "optimization." Although the blocks' sizes vary greatly, the diversity of the smaller ones indicates a multidisciplinary research environment by reflecting the vast range of subfields of interest, such as "big data," "neural networks," and "decision-making."

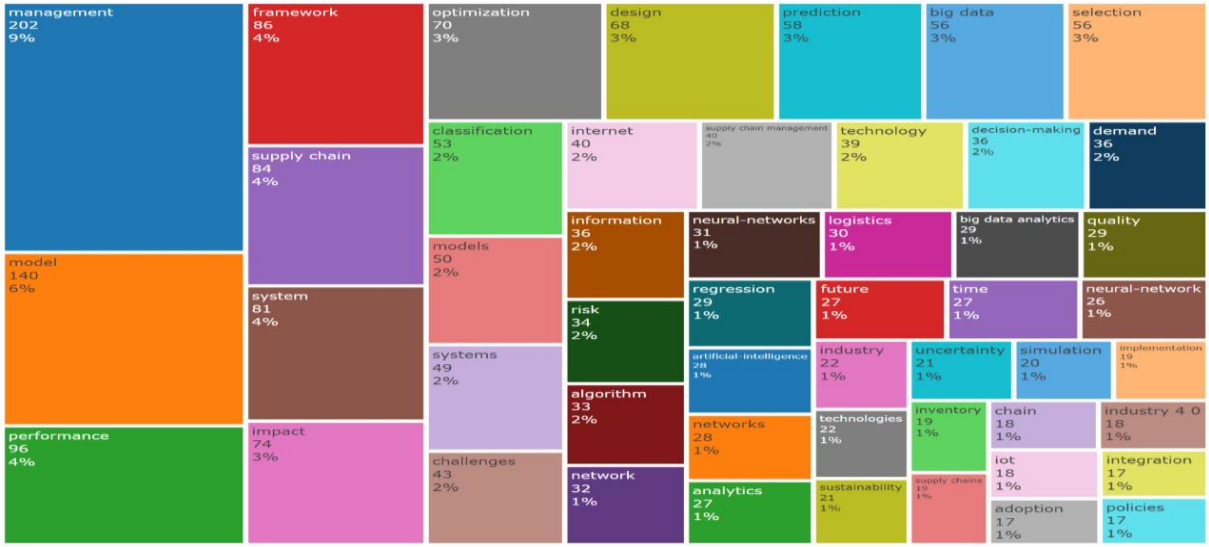

Figure-7: Research Focus Tree map

The figure 7 describe most frequent words found in the study are shown in this word cloud; the larger the term, the more frequently it appeared. The terms "management," "performance," "big data analytics," and "supply chain management" are highly indicative. Terms like "framework," "integration," and "innovation" imply a strong focus on theoretical developments and real-world implementations.



Figure-8: Word Cloud

The idea of "relevance degree" (x-axis, Centrality) and "development degree" (y-axis, Density) are distinguished in diagram 9, which depicts a thematic map with each study theme falling into one of four quadrants: Niche Themes, Motor Themes, Emerging or Declining Themes, and Basic Themes. Although they have less connections to other themes, niche topics like "accuracy" or "inventory control" appear to be very well-formed. In Motor Themes, the keywords "integration" and "innovation"—two crucial terms in the automotive industry—are both highlighted and discussed. "Spectroscopy" is an example of an emerging or declining theme that is less developed, less pertinent, and may grow or shrink in significance. Lastly, some phrases that are essential to the field but may not be highly specialized or detailed are management, model, and performance.

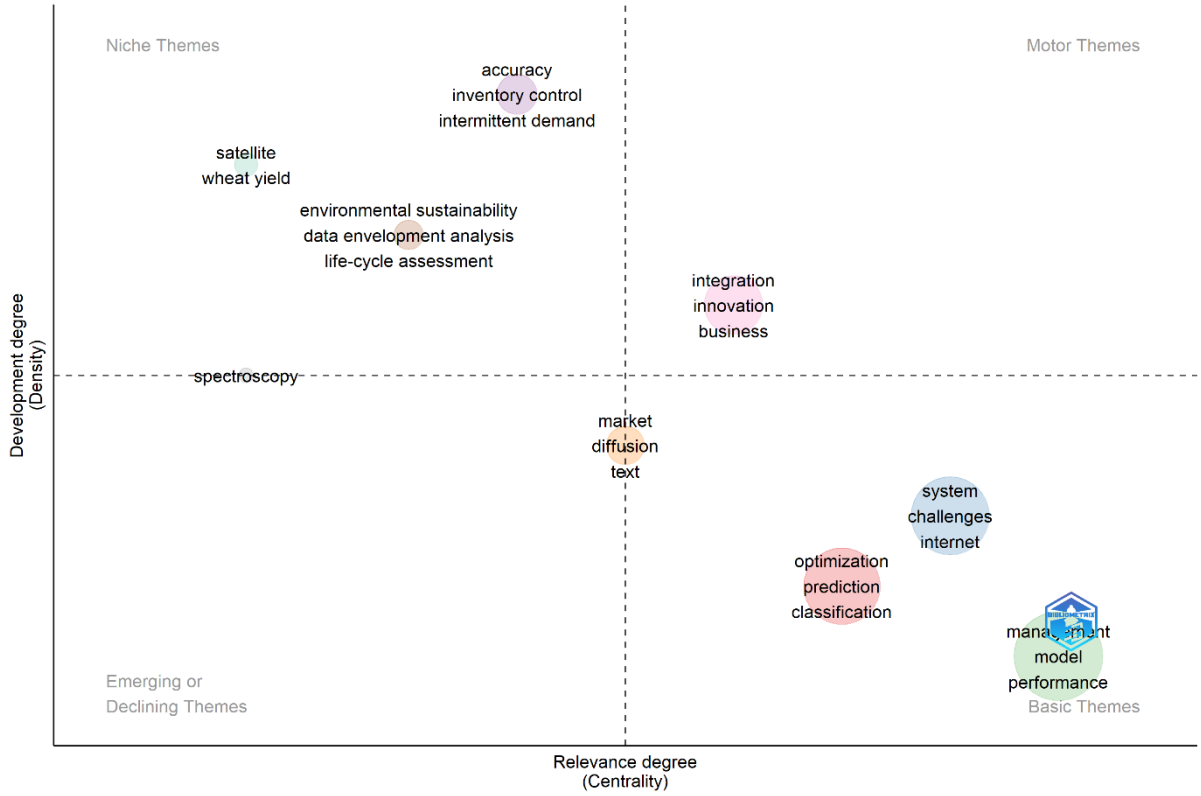

Figure-9: Thematic Landscape of Research Trends

In this figure 10, bibliometric approaches were used to conduct a thorough investigation of the intellectual structure and research trends in the chosen field. The Web of Science database was utilized in the analysis to identify the key works, authors, and themes that characterize the discipline. The findings point to important areas of concentration, such as "supply chain management," and they also identify research gaps and opportunities. In figure 11 use of visualization tools like the VOS viewer, a combination of citation, co-citation, and keyword co-occurrence analysis allowed for the identification of the thematic clusters and the evolution of the field over time. The results serve as a foundation for more study and theory development in addition to offering practitioners and researchers useful insights. This study concludes by highlighting the field's dynamic nature and laying the groundwork for upcoming theoretical and practical advancements.

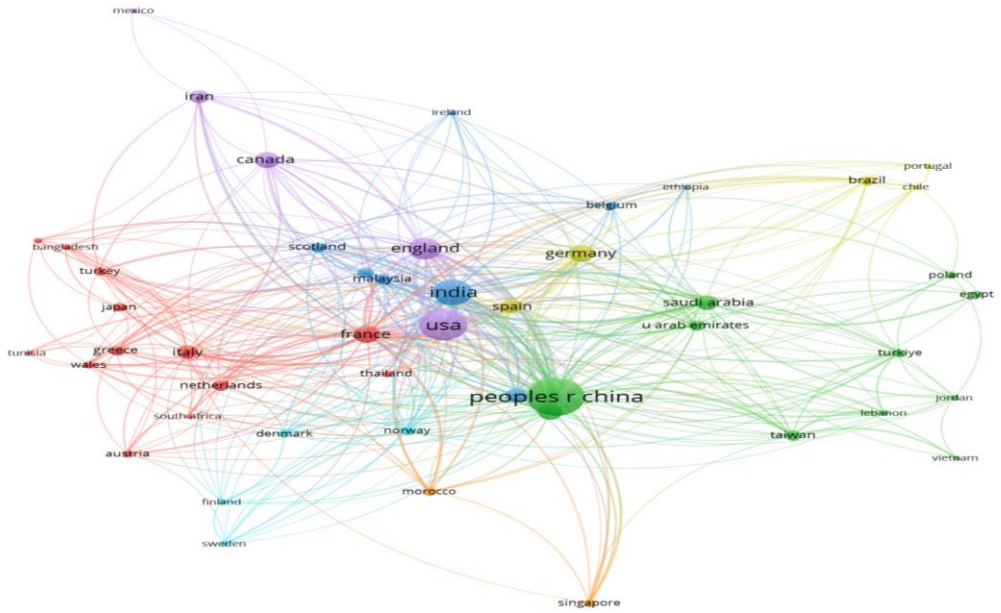

Figure-10: coauthor ship and countries

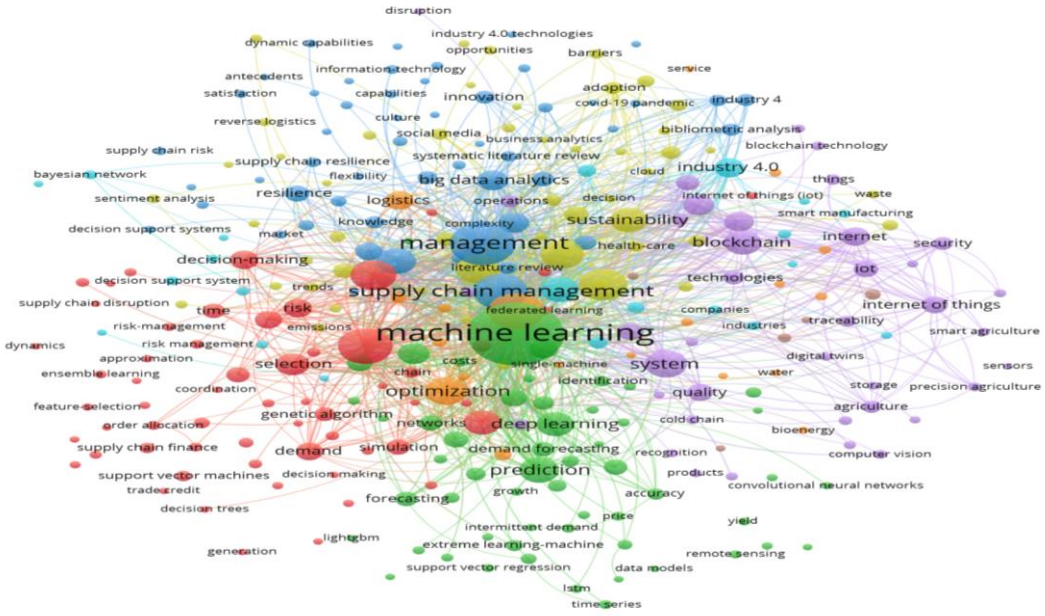

Figure-11: Co-occurrence with keywords

Conclusion

This study has limitations even if it sheds light on the field's research patterns and conceptual framework. First, the analysis is limited by the use of data from the Web of Science database, which may not include pertinent papers that are indexed in other databases like IEEE Xplore or Scopus despite its coverage. Second, although bibliometric methods are effective at spotting patterns and trends, they don't go deeper into the qualitative or substance of the studies, which restricts how the results can be interpreted. Furthermore, the study's 2000–2025 timeframe might not adequately reflect advancements in quickly changing fields. Future studies could overcome these constraints by extending the temporal or thematic focus to include cutting-edge areas like supply chain sustainability or blockchain integration, as well as by incorporating data from sources using mixed-methods approaches that combine bibliometric analysis with content analysis. Our

knowledge of the field would be enhanced by these initiatives. Provide more in-depth perspectives for academia and business.

Acknowledgement

The author gratefully acknowledges the Government of Odisha for its support and initiatives, under MRIP(2025-2028), which have contributed to the research and development environment in the state. The author also appreciates the support and resources that facilitated the completion of this research.

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