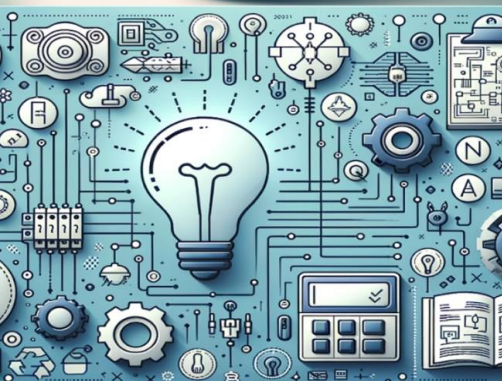


International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.206

Volume 8, Issue 4, April 2025



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Block chain Technology Logistics in Supply Chain Management

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ABSTRACT: The rise of blockchain technology has garnered considerable interest within the fields of supply chain management (SCM) and logistics. This paper presents a comprehensive bibliometric review aimed at analytically and objectively uncovering the intellectual foundation of this research domain, highlighting key publications and influential scholars. Utilizing knowledge domain visualization techniques, the study offers deeper insights that extend beyond those of prior review studies focused on blockchain in logistics and SCM. The analysis is based on a dataset of 628 research articles sourced from Scopus and Web of Science, published between 2016 and 2020. Results from the bibliometric analysis reveal a sharp increase in blockchain-related publications starting in 2017, with leading contributions coming from researchers in the USA, China, and India. The study also identifies the top academic institutions driving research in this area. Network analysis shows that current literature is primarily centered around blockchain conceptualization, its potential to enhance supply chain sustainability, the drivers and barriers to its adoption, and its application in improving agility, trust, intellectual property protection, and food/perishable supply chains. Beyond mapping the existing literature, the paper highlights key research gaps and suggests actionable directions for future investigation. Overall, this study offers a timely and evidence-based overview of the knowledge structure in blockchain research within the logistics and SCM landscape.

KEYWORDS: blockchain, supply chain management, logistics, bibliometrics, network analysis.

I. INTRODUCTION

Modern supply chains have undergone significant transformation, evolving from a purely operational role to a comprehensive supply chain management (SCM) function. These complex systems encompass various logistics processes such as planning, execution, and control of goods, services, and information flow, all aimed at meeting customer demands efficiently. As supply chains grow more intricate, due to the involvement of numerous independent and globally distributed entities, they face increased risks and uncertainties, including fraud, cyber threats, privacy breaches, and counterfeit goods. To address these challenges, businesses are increasingly embracing digitalization—adopting inter-organizational systems to boost collaboration, enhance traceability, and improve agility and responsiveness across the network. One of the most promising innovations in this space is blockchain technology, which offers decentralized, tamper-proof records and enables secure, transparent, and trustless transactions. Originally developed for cryptocurrencies, blockchain has expanded into sectors like logistics and SCM, offering solutions for data transparency, secure transactions, and sustainable operations. Despite growing interest and a surge in related publications, there is limited research analyzing the intellectual structure of blockchain within SCM. This study addresses that gap by applying knowledge domain visualization and network analysis to map the current state of research, highlight influential authors, and suggest future research directions in this rapidly evolving field.

OBJECTIVE

The primary objective of this study is to systematically analyze and map the intellectual structure of blockchain research within the domain of supply chain management (SCM) and logistics. While blockchain has gained substantial attention for its transformative potential in enhancing transparency, traceability, security, and collaboration across supply chains, existing literature largely focuses on conceptual and application-based studies. There is a noticeable lack of research that critically examines the development, trends, and key contributors within this academic field. This study aims to fill that gap by employing bibliometric and scientometric techniques, particularly knowledge domain visualization, to offer an evidence-based overview of the field's evolution. By analyzing a curated set of 628 publications from leading databases such as Scopus and Web of Science (2016–2020), the study seeks to identify the



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most influential authors, seminal papers, core research themes, and prominent institutions driving blockchain research in logistics and SCM. Furthermore, the objective is to uncover collaboration patterns and emerging research fronts while highlighting areas where further investigation is needed. Ultimately, the study intends to serve as a comprehensive reference for scholars and practitioners, guiding future research efforts, fostering collaboration, and supporting the strategic development of blockchain applications in the supply chain and logistics sector.

II. LITREATURE SURVEY

Blockchain technology has emerged as a transformative force in logistics and supply chain management (SCM), offering new paradigms for transparency, trust, and efficiency. Kshetri (2018) presents blockchain as a key driver for improving traceability and visibility in supply chains, especially in addressing issues like fraud and counterfeiting. Francisco and Swanson (2018) build on this by highlighting blockchain's capacity to improve transparency and trust among supply chain partners through decentralized, tamper-proof records.

Queiroz et al. (2019) conducted a comprehensive review identifying how blockchain applications are reshaping the landscape of SCM, particularly by enhancing performance metrics and reducing information asymmetry. Saberi et al. (2019) explore blockchain's potential in driving sustainable supply chains by ensuring ethical sourcing, waste reduction, and improved environmental practices.

Min (2019) provides critical insights into the implications of blockchain for supply chain resilience, emphasizing its role in real-time tracking and risk mitigation during disruptions. Kouhizadeh et al. (2021) investigate the barriers to blockchain adoption, citing technological immaturity, high costs, and lack of standardization as key challenges.

Wang et al. (2019) contribute by proposing a future research agenda that stresses the need for interoperability, data privacy, and effective governance structures. Dujak and Sajter (2019) illustrate practical use cases of blockchain in logistics operations, showcasing its applicability in inventory management, transportation, and customer service.

Pournader et al. (2020) extend the discourse by evaluating blockchain applications across broader sectors, offering a multi-dimensional view of its integration with Industry 4.0 technologies. Lastly, Lee and Suh (2020) focus on trust-building mechanisms, suggesting that blockchain enhances inter-organizational collaboration by reducing dependency on third-party verification.

Collectively, these studies establish a strong theoretical and empirical foundation for understanding the role of blockchain in revolutionizing logistics and SCM, while also identifying avenues for future exploration and practical implementation.

III. CONSENSUS MEDHODOLOGIES

To ensure a comprehensive and reliable analysis of blockchain applications in logistics and supply chain management (SCM), the study adopted a structured and consensus-driven methodological approach. The research process was grounded in bibliometric analysis, which offers a quantitative and objective means of mapping academic literature, identifying influential works, detecting knowledge clusters, and tracking evolving trends within the domain. This methodology is widely recognized for its ability to handle large volumes of data while minimizing subjectivity, making it an ideal choice for consensus-building in literature reviews.

Initially, a systematic search was performed using Scopus and Web of Science databases, employing well-defined keywords such as "blockchain," "supply chain," and "logistics." These databases were selected for their vast academic coverage, credibility, and advanced filtering functionalities. After refining the search based on subject areas, document types, language, and peer-reviewed status, 628 relevant publications were identified for further investigation. These articles formed the consensus base for the ensuing analysis.

To identify key research themes and interrelationships, the study utilized bibliometric tools such as BibExcel, Gephi, and VOSviewer. BibExcel was employed to preprocess citation and keyword data, enabling compatibility with visualization software. Gephi was then used to perform co-citation network analysis, which clusters publications based on shared references. This method reflects consensus in the academic community by highlighting frequently cited works that serve as foundational studies in the field.

In parallel, a keyword co-occurrence analysis was conducted using VOSviewer. This technique identifies thematic patterns by examining how often specific keywords appear together in different publications. By doing so, it highlights prevailing research areas and allows for monitoring of topic evolution, thus building consensus on dominant and emerging themes in blockchain-related SCM research.

The integration of these consensus methodologies—systematic search, citation analysis, and keyword mapping—ensures objectivity, replicability, and robustness in findings. Moreover, by focusing on citation frequency and keyword



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relationships, the study effectively captures the collective knowledge and direction of scholarly work in the field. This methodological framework ultimately supports informed decision-making and future research by consolidating expert insights and establishing consensus across the academic literature.

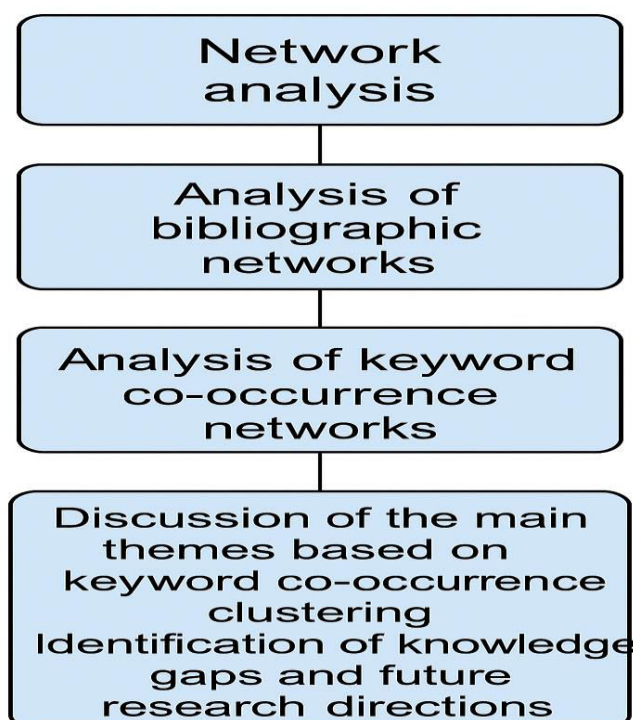
IV. NETWORK ANALYSIS

Following the network analysis of the selected publications, a detailed investigation into the underlying patterns and research trends was conducted through network analysis. To uncover the intellectual structure and evolving themes in blockchain-related logistics and supply chain management (SCM) literature, bibliometric data were employed using visualization tools—primarily Gephi and VOSviewer.

The co-citation analysis, a widely recognized bibliometric technique originally proposed by Henry Small in 1973, was used to evaluate the semantic proximity between papers that share common references. This concept, known as bibliographic coupling, identifies the degree of relatedness between two articles based on the number of shared citations. A higher co-citation frequency signifies a stronger thematic connection between the documents. The references of each publication served as the primary input for this co-citation analysis.

The bibliometric data, extracted and structured using BibExcel, were imported into Gephi to create a co-citation network. Several preprocessing steps were performed to ensure the data were clean and appropriate thresholds for co-citation frequency were determined. A high threshold might limit the network to only a few clustered articles, while a low threshold could generate an excessively fragmented structure. To produce an effective visualization, the circle pack layout—recommended in prior bibliometric research—was applied in Gephi. Each node in the network represented a publication, and each connecting edge indicated a co-citation link. Manual adjustments were made to node size, hierarchy, and color to enhance clarity and interpretability, effectively regularizing the visual clusters.

To further enrich the understanding of blockchain research in logistics and SCM, a keyword co-occurrence network was constructed. This approach analyzes author-assigned keywords, identifying relationships based on their frequency of co-appearance across papers. Such analysis, as described by Lee and Su, enables the identification of major research themes and the tracking of shifting scholarly focus over time. VOSviewer, a tool compatible with BibExcel, was used to generate this network. The size of each node indicated the keyword's frequency, while edge thickness reflected the strength of co-occurrence. This visualization provided meaningful insights into dominant topics, interconnections among themes, and the current research landscape in blockchain applications within logistics and SCM.





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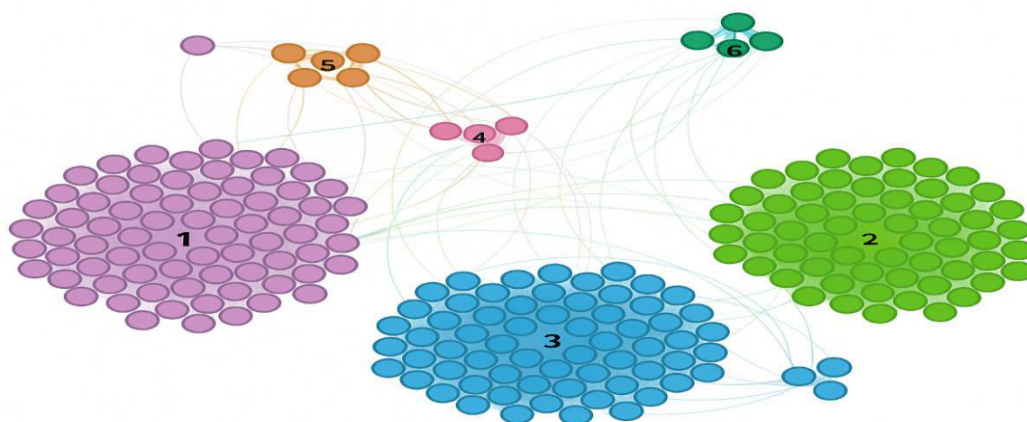
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V. NETWORK ANALYSIS AND DISCUSSION

Following the methodology of previous studies, a threshold of 2 was set for co-citation frequency to filter meaningful connections within the bibliographic data. This threshold yielded a bibliographic coupling network comprising 296 papers. In such a network, nodes (representing papers) are organized into clusters where the intra-cluster connectivity is significantly higher than inter-cluster links. Each cluster groups papers that share strong thematic and citation-based relationships related to blockchain research in supply chain management (SCM) and logistics. These clusters reveal the structural topology of the research domain, helping to uncover prevalent themes, relationships, and collaboration patterns.

To generate the co-citation network, the Gephi software's modularity function was employed, utilizing the Louvain algorithm—an optimization-based approach that identifies the most effective number of clusters by maximizing a modularity index. This index, ranging from -1 to 1, assesses the strength of division of the network into distinct communities. In this study, six major clusters were identified, with the modularity index calculated at 0.151. This value suggests a moderately structured network with significant interconnections among the identified communities.

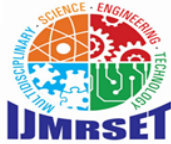
The clusters vary in size, ranging from as few as 2 papers in the smallest cluster (Cluster 6) to 101 papers in the largest cluster (Cluster 1). Each cluster was found to represent a distinct thematic area, with closely linked papers likely exploring similar research questions or conceptual frameworks. To gain deeper insights, only the top ten most influential articles from each cluster were selected for further content analysis. These lead papers were identified using the PageRank algorithm within the network, reflecting their importance based on citation connectivity. The main focus of each cluster was then derived by examining the content of these key papers, enabling researchers to label and categorize each group by its dominant research theme.



VI. CONCEPTUAL DEVELOPMENT OF BLOCKCHAIN RESEARCH IN THE FIELD OF LOGISTICS AND SCM

Although there is some thematic overlap between clusters 2 and 3 in the area of theory development, the primary focus of the leading papers in cluster 2 lies in advancing the conceptual foundations of blockchain technology. The key publications in this cluster are largely exploratory, aiming to establish a solid theoretical basis for understanding blockchain within the context of logistics and supply chain management (SCM). These studies do not necessarily present empirical findings, but instead aim to frame blockchain as a transformative technology by exploring its potential, mechanisms, and implications for supply chains.

The nature of the work within cluster 2 highlights an early stage of academic inquiry, where scholars are primarily concerned with defining, explaining, and structuring the emerging field. The prevalence of conceptual and review papers—such as those by authors referenced in studies underscores the critical need for a common language, shared definitions, and comprehensive theoretical models that can guide further empirical investigations. These works often provide taxonomies, frameworks, and theoretical discussions that help shape the understanding of how blockchain can be integrated into logistics and SCM operations.



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Moreover, the contributions in this cluster emphasize identifying the unique attributes of blockchain, such as decentralization, transparency, and immutability, and explore how these features can address persistent challenges in supply chains, including trust, traceability, and coordination. By framing these core capabilities in a logistics and SCM context, cluster 2 offers a foundational knowledge base upon which future research can build.

In essence, cluster 2 serves as a theoretical anchor for blockchain research in logistics and SCM. It plays a critical role in conceptualizing the field, setting the stage for more specialized and empirical studies, and encouraging scholars to engage with the foundational principles and potential of blockchain technology.

VII. FUTURE PROSPECTS

The future prospects of blockchain research in logistics and supply chain management (SCM) are promising and multifaceted. As the technology matures, future studies are expected to move beyond conceptual frameworks and explore real-world implementations, evaluating performance outcomes such as efficiency, transparency, cost reduction, and sustainability. Integration with emerging technologies like the Internet of Things (IoT), Artificial Intelligence (AI), and digital twins will likely be a key focus, enabling smarter, more autonomous supply chains. Additionally, future research should address regulatory, ethical, and interoperability challenges that hinder large-scale adoption. Scholars may also explore blockchain's role in enhancing resilience and risk management in global supply chains, especially in the face of disruptions like pandemics or geopolitical tensions. Furthermore, comparative studies across industries and regions can offer deeper insights into best practices and contextual factors. Overall, the future of blockchain in logistics and SCM lies in interdisciplinary approaches and evidence-based strategies that support scalable and sustainable innovation.

VIII. CONCLUSION

In conclusion, this study offers a comprehensive bibliometric and network analysis of blockchain research within the domain of logistics and supply chain management (SCM). By leveraging tools such as BibExcel, Gephi, and VOSviewer, we examined the evolution of the research field through co-citation and keyword co-occurrence networks. These methodologies enabled us to identify thematic clusters, core research topics, influential publications, and emerging trends. The use of the Louvain modularity algorithm facilitated the identification of six distinct clusters within the co-citation network, each representing specific focus areas ranging from foundational theories to practical applications of blockchain in logistics.

Cluster 1 emerged as the largest and most influential, encompassing empirical studies and practical implementations, while Cluster 2 focused on the conceptual development of blockchain frameworks. Cluster 3 was dedicated to exploring business models and strategies, and the remaining clusters—though smaller—highlighted niche areas such as digital identity, traceability, and sustainability. By analyzing the most cited papers within each cluster, the research mapped the intellectual structure of the field and revealed the intricate relationships among studies.

Moreover, the keyword co-occurrence analysis complemented the co-citation findings, highlighting frequently addressed topics such as transparency, traceability, smart contracts, and decentralized systems. This dual approach provided a robust understanding of both the foundational and progressive elements in blockchain research applied to logistics and SCM.

The findings of this study are significant in identifying key knowledge gaps and offering direction for future research. Although blockchain presents vast potential in optimizing supply chain operations, challenges such as scalability, interoperability, and regulatory compliance remain underexplored. Future research should aim to deepen theoretical development, investigate real-world adoption barriers, and evaluate long-term implications across various supply chain contexts.

Ultimately, this bibliometric analysis lays the groundwork for future studies and helps scholars, practitioners, and policymakers better understand the trajectory and impact of blockchain technology in transforming global supply chains.



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