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Mapping the Intellectual Landscape of Mining Supply Chain Management: A Bibliometric Review

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Abstract

Mining supply chain management (MSCM) is an interdisciplinary and increasingly complex research field that integrates sustainability, risk management, logistics, and technological innovation. Despite the growing number of publications in this domain, there has been a notable absence of a comprehensive bibliometric review to systematically analyze and synthesize the existing body of knowledge. This study aims to address this gap by conducting a detailed analysis of 152 research articles published between 2003 and 2025, retrieved from the Web of Science database. Therefore, the main research question was to explore the thematic and conceptual areas of the mineral supply chain and provide quantitative, analyzable information to understand the necessity and importance of studying this area. Utilizing advanced bibliometric tools such as VOSviewer, the literature was categorized into nine thematic areas, including environmental protection, logistics, inventory control, economic issues, and technological advancements. The analysis not only identifies leading authors and high-impact journals but also examines publication trends and keyword clusters, providing valuable insights into the intellectual structure and evolution of MSCM over the past two decades. Key findings from the study reveal a significant shift in research focus toward sustainability, resilience, and digitalization in recent years, reflecting the growing importance of these themes in addressing contemporary challenges in the mining industry. Additionally, the study highlights critical research gaps, particularly in the development of robust risk management models and comprehensive sustainability frameworks, which are essential for enhancing the effectiveness and efficiency of mining supply chains. The findings underscore the need for future interdisciplinary research that bridges these gaps and explores innovative solutions to the complex challenges faced by the mining sector. By providing a comprehensive bibliometric review of the current state of MSCM research, this study provides a foundation for advancing knowledge and a roadmap for future academic and practical efforts in this area.

1- Introduction

In recent decades, supply chain management (SCM) has evolved into a strategic pillar for operational excellence, particularly in industries facing complex, global, and capital-intensive challenges. Among these, the mining industry occupies a distinct position due to its reliance on long-term infrastructure, extensive resource consumption, and exposure to environmental and market risks. Managing the full life cycle of mining operations—from exploration and extraction to processing, logistics, and rehabilitation—requires seamless integration across multiple actors and activities. As a result, mining supply chain management (MSCM) has emerged as a critical subfield of industrial engineering, where optimizing logistics, enhancing resilience, and promoting sustainability are intertwined imperatives [1-3].

Despite increasing attention to MSCM, the related academic literature is highly fragmented. Existing studies often focus on isolated components such as transportation systems, environmental compliance, inventory optimization, or risk mitigation strategies, without offering a consolidated view of how these themes interrelate or have evolved over time. Moreover, while technological shifts, such as digitization, automation, and artificial intelligence, have significantly influenced mining operations and their supply chains, their conceptual and practical integration into the literature remains underexplored. The field is further complicated by growing demands for sustainable practices, stakeholder accountability,

and resilience to global shocks such as pandemics or geopolitical instability [4 & 5].

In this context, bibliometric analysis provides a powerful tool for mapping the development of research domains, uncovering intellectual structures, and identifying emerging trends. Bibliometric reviews quantitatively evaluate academic publications, trace patterns in co-authorship, citation, and keyword networks, and help define the boundaries of complex interdisciplinary fields. In recent years, bibliometric methods have been successfully applied in areas such as innovation ecosystems [6], educational policy [7], data science and analytics [8], financial engineering [9], and sustainable engineering education [10]. These studies not only reveal influential scholars and journals, but also clarify research gaps and forecast future agendas [11–13].

Moreover, recent bibliometric findings show a strong trend toward convergence of disciplines, particularly in engineering-related studies. Topics like big data, blockchain, green logistics, and resilient infrastructure have reshaped how researchers approach traditional supply chain problems [8, 14]. These developments have emphasized the role of collaborative networks, knowledge integration, and co-authorship in driving innovation and scholarly productivity [15]. However, bibliometric analysis within the mining supply chain literature remains scarce, and no comprehensive effort has yet mapped its intellectual evolution, thematic composition, and research dynamics.

To address this gap, the present study conducts a systematic bibliometric review of the mining supply chain literature. A total of 152 articles, published between 2003 and 2025, were retrieved from the Web of Science (WOS) database using carefully constructed search queries to exclude unrelated fields (e.g., text mining, data mining). Utilizing tools such as VOSviewer, the study explores thematic clustering, co-authorship networks, publication trends, and citation metrics. The literature is categorized into nine thematic domains, including environmental protection, logistics, inventory control, economic risk, and network design. In addition to identifying prominent journals, authors, and articles, this paper highlights critical research gaps—especially in areas such as sustainability integration, advanced analytics, and risk management frameworks—and offers recommendations for future interdisciplinary and practice-oriented investigations [16].

2- Methedology

This study employs a bibliometric analysis to explore the intellectual structure and research evolution in the field of mining supply chain management. The methodology consists of three main phases: data collection, data refinement, and bibliometric analysis.

2-1- Data Collection and Search Strategy

The bibliographic data were retrieved from the Web of Science (WOS) Core Collection, a leading citation indexing database widely used in scientific research. The search was conducted in June 2025, targeting journal articles published in English from 2003 to 2025.

In this query, “Supply Chain” was required to appear in the title of the article, while “Mining” was allowed to appear in the title, keywords, or abstract. The terms "Text mining" and "Data Mining" were explicitly excluded using the NOT operator to filter out unrelated articles from computer science and data analysis domains, where the term "mining" is often used metaphorically.

2-2- Inclusion and Exclusion Criteria

Only peer-reviewed journal articles written in English and directly related to physical mining supply chains were included. Other types of documents, such as conference proceedings, review papers unrelated to mining, non-English publications, and studies focusing on data/text mining, were excluded. After the screening process, a total of 152 relevant articles remained and formed the final dataset for analysis. Fig. 1 shows the flowchart of literature-review methodology.

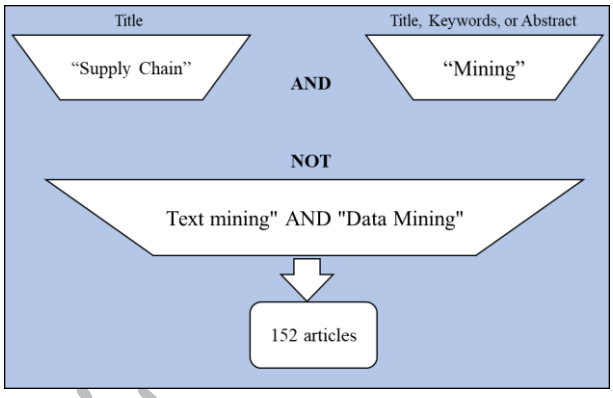

Fig. 1. The flowchart of literature-review methodology

2-3- Bibliometric Tools and Analysis

The refined dataset was exported in CSV format from WOS and analyzed using VOSviewer—a software tool for constructing and visualizing bibliometric networks. The following types of analysis were performed: Co-authorship analysis (authors and institutions), Co-occurrence of keywords, Citation and co-citation analysis, Thematic clustering based on keyword networks. Additionally, Microsoft Excel was used for descriptive statistical analysis such as the number of publications per year, distribution by journal, and citation frequencies.

3- Discussion: Mining Supply Chain and Thematic Classification of Literature

Mining is a capital-intensive process involving the extraction of raw mineral materials from the earth. The mining operation is typically structured into what is referred to as the mine life cycle, which includes phases such as exploration, production, and ultimately closure [17]. As a part of the upstream segment of mineral supply chains, mining activities are interconnected with subsequent phases involving the sale and processing of mineral products. This upstream segment spans not only the production of raw and final products but also stages such as retail, consumption, recycling, and post-production handling.

Fig. 2 illustrates a general model of the mining supply chain, representing its classification into interconnected stages [18]. This upstream model includes the following: exploration, infrastructure development, mine establishment, extraction, processing, product sales, and site rehabilitation [19]. Effective supply chain management within mining (MSCM) incorporates strategic, tactical, and operational planning, including activities such as mine site selection, layout design, surface and underground mining operations, raw material processing, inventory control, waste disposal, delivery to end-users, and post-closure sustainability management.

MSCM also facilitates coordination across the flow of materials, finance, human resources, and environmental obligations, promoting mutual benefit among all involved entities [20].

The literature in the field of MSCM can be broadly categorized into nine thematic clusters, as summarized in Table 1. These themes represent a combination of mining-specific concerns (e.g., environmental protection), logistical and operational factors (e.g., inventory, network design), and economic/financial considerations. These clusters reflect the growing relevance of green, sustainable, and socially responsible supply chains in the mining context, particularly in light of increasing regulatory and environmental constraints [21].

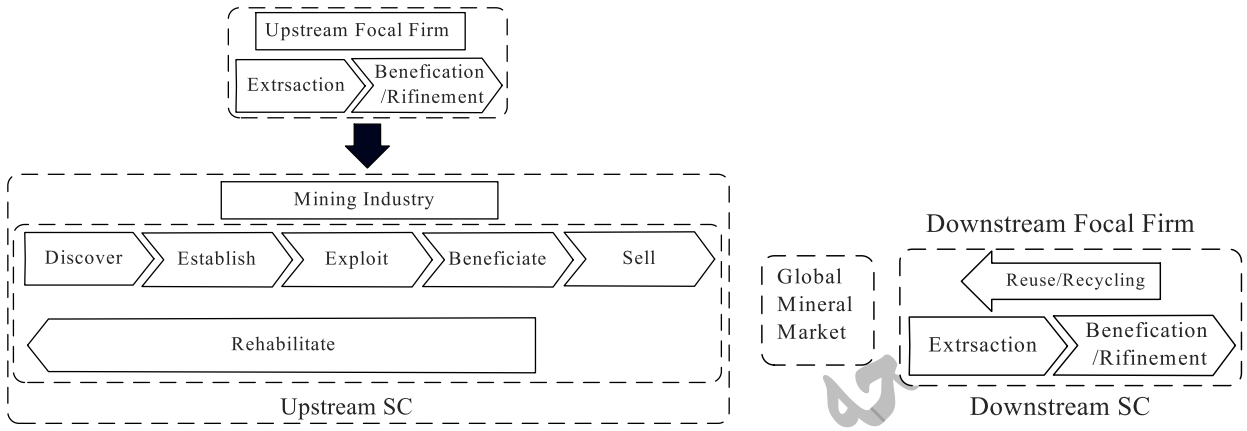

Fig. 2. Mining supply chain model

Table 1. Thematic classification of mining supply chain management literature [22]

The background of literary classification	Issue
Mining background	Environmental protection in MSCM
Supply chain background	Logistics in MSCM Inventory control in MSCM Network design in MSCM Capacity planning in MSCM Efficiency evaluation in MSCM
Economic background	Risk control in MSCM Production scheduling in MSCM Economic issues in MSCM

Table 2 presents key articles for each of the nine thematic categories based on citation impact. In the area of environmental protection, most research emphasizes the coal supply chain, which faces challenges related to logistics, regulatory compliance, and sustainability [23]. These include issues such as greenhouse gas emissions, infrastructure inadequacies, and handling of hazardous materials [24–26].

The COVID-19 pandemic further exposed vulnerabilities in the logistics performance of coal and other mining supply chains, prompting calls for technology-driven, innovative solutions [27].

In the domain of risk management, bibliometric analysis provides a strategic framework to identify key vulnerabilities—including natural disasters, regulatory shifts, and market volatility. Recent studies underscore the importance of incorporating resilience frameworks into mining SCM to mitigate these risks [26–29].

Resilience theory, which considers four dimensions—machinery, human factors, general operational uncertainty, and environmental risks—has proven effective in enhancing system recovery and adaptability. Integrating best practices in technical innovation, human capital development, and monitoring systems are essential pillars of this framework [28–30].

Despite advancements, current risk management models often fall short in addressing fast-evolving technological and geopolitical uncertainties. Therefore, an adaptive organizational culture rooted in continuous innovation, learning, and collaborative planning is essential [30, 31].

Table 2. Key articles for each topic and their purpose

Reference	Environmental protection in MSCM	
	Article	Objective
[32]	Case history of environmental impacts of an Indonesian coal supply chain	Utilize life cycle assessment techniques to reduce greenhouse gas emissions, fossil fuel consumption, and water usage.
[33]	A new sustainable closed-loop supply chain model for mining industry considering fixed-charged transportation: A case study in a travertine quarry	Examine the sustainability aspects of quarry mining through a mathematical optimization approach.
[34]	Analysing sustainable concerns in diamond supply chain: a fuzzy ISM-MICMAC and DEMATEL approach	Identify existing concerns regarding sustainability and classify the main drivers of a sustainable supply chain.
	Logistics in MSCM	
	Article	Objective
[35]	Supporting a Lithium Circular Economy via Reverse Logistics: Improving the Preprocessing Stage of the Lithium-Ion Battery Recycling Supply Chain	Enhance the circular economy by identifying technical requirements and assessing the efficiency of the downstream sector through reduced transfer pathways.
[36]	A mathematical model for potash supply chain management with a strategic logistics perspective	Optimize logistics to increase the efficiency and sustainability of the potash supply chain.
[37]	Logistics optimization for a coal supply chain	Develop a mathematical logistics planning system for Australian coal.
[38]	Prioritization and Supply Chain Logistics as a Marketing Function in a Mining Company	Evaluate the impact of logistics optimization on reducing economic pressures.
	Inventory control in MSCM	
	Article	Objective
[39]	Misconception of providing supply chain finance: Its stabilising role	Examine the impact of supply chain financing on company financial performance and inventory management.
[40]	Designing a resilient and green coal supply chain network under facility disruption and demand volatility	Assess inventory retention strategies for designing a resilient and green supply chain network.
[41]	Emission impacts of China's solid waste import ban and COVID-19 in the copper supply chain	Model the responses of each stakeholder in the copper supply chain to disruptions.
	Network design in MSCM	
	Article	Objective
[42]	Designing an environmental supply chain network in the mining industry to reduce carbon emissions	Design a supply chain considering environmental challenges.
[43]	Developing benders decomposition algorithm for a green supply chain network of mine industry: Case of Iranian mine industry	Create a three-tier supply chain network for the mining industry.
[44]	Resilient closed-loop supply chain network design considering quality uncertainty: A case study of stone quarries	Optimize the design of the mining supply chain.
[45]	Designing a resilient and sustainable closed-loop supply chain network in copper industry	Design a copper network using backup suppliers to enhance resilience.

Table 2.

	Capacity planning in MSCM	
	Article	Objective
[46]	Supply Chain Resilience of Mineral Resources Industry in China	Simulate the resilience of the mining industry supply chain under scenarios of economic development and crisis.
[47]	A supply chain based assessment of water issues in the coal industry in China	Provide technical and policy recommendations for the main challenges of the coal supply chain.
[48]	Arsenic leakage crisis in supply chain of battery storage materials: Water quality footprint of cobalt mining demands action	Model supply and demand to reduce the environmental impacts of the cobalt supply chain..
	Efficiency evaluation in MSCM	
	Article	Objective
[49]	An integrated steering approach to improve a phosphate supply chain efficiency	Model flexible and reactive management considering customer needs and cost minimization.
[50]	Resilience in the antimony supply chain	Examine disruptions in the antimony supply chain and the impact of resilience strategies.
	Risk control in MSCM	
	Article	Objective
[51]	Identifying supply risks by mapping the cobalt supply chain	Determine the vulnerability of primary cobalt production to supply chain disruptions and assess potential supply risks.
[52]	Mapping global platinum supply chain and assessing potential supply risks	Analyze upstream supply chain risks.
[28]	Mining industry risks, and future critical minerals and metals supply chain resilience in emerging markets	Create a resilient framework for the mining industry supply chain to ensure a steady supply of raw materials.
	Production scheduling in MSCM	
	Article	Objective
[53]	Scheduling of maintenance windows in a mining supply chain rail network	Manage rail system maintenance for supply chain efficiency.
[54]	Integrated scheduling of a multi-site mining supply chain with blending, alternative routings and co-production	Optimize blending operations, alternative routes, and order planning with a shared production flow.
	Economic issues in MSCM	
	Article	Objective
[55]	The effect of local supply chain on regional economic impacts of mining	Guide the local procurement supply chain to create value and sustainable outcomes.
[56]	Understanding key mineral supply chain dynamics using economics-informed material flow analysis and Bayesian optimization	Develop a homogeneous and probabilistic approach to identify economic relationships in mineral supply chains.

3-1- Research Gaps and Future Research Opportunities

Key research gaps in MSCM are influenced by four core limitations: sustainability integration, data analytics adoption, risk management limitations, and technological transformation. For example, although sustainability and resilience are critical for supplier selection, current frameworks often overlook environmental and social responsibilities [57]. Likewise, data analytics are underutilized due to skill gaps and lack of collaboration infrastructure [58].

In issues related to sustainable, resilient and lean supply chains and similar management concepts, there is still no specific framework for performance evaluation and analysis. Although key performance indicators can be extracted from the literature to some extent in terms of application, there is still no logical framework for this. For this reason, they can be included in the set of research gaps as details of the above-mentioned items.

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Risk management models lack empirical depth and often fail to cover risk response strategies, as highlighted in prior meta-analyses [59&60]. There is also insufficient integration of data mining and digital technologies to improve operational agility.

In supply chain risk management, due to the dynamic nature of this concept and the differences from one industry to another, there is still no unified and clear framework for controlling and managing risks. Although the SCOR model has been used in this field, unfortunately, despite the newer uncertainties in supply chain management, there is a great need for new approaches and methods in this regard.Furthermore, complex global challenges—such as climate change, supply disruptions, and technological acceleration—require mining firms to adopt strategic long-term planning, beyond tactical solutions. Sustainable development in MSCM depends on interdisciplinary frameworks, ESG alignment, and localized solutions integrated with international standards [61–63].

3-2- Trends in Publications and Citation Metrics

From 2003 to 2012, the field saw limited publications (25 articles), but from 2013 onward, interest surged, peaking in 2024 with 41 articles (Fig. 3). The slight decline in 2025 is due to the data being extracted mid-year. The shift in perspective on mining issues from a traditional perspective to a systems thinking perspective has led researchers to engage in the discussion of mineral supply chain issues. Also, after the COVID-19 pandemic, the publication of supply chain-related articles has increased, and this growth is also reflected in the mineral supply chain; as can be seen, growth will be seen at a steeper rate from 2022 onwards.

Fig. 4 lists the most active journals, led by Resources, Conservation & Recycling (15 articles), Resources Policy (14), and International Journal of Production Research (12). Table 3 showcases highly cited articles (over 100 citations), covering themes like green SCM, blockchain traceability, and supply chain risk analytics.

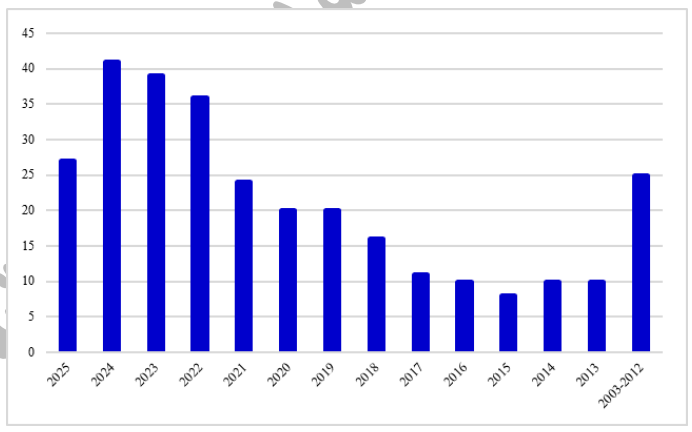

Fig. 3. Publications evolution over time from 2003 to 2025

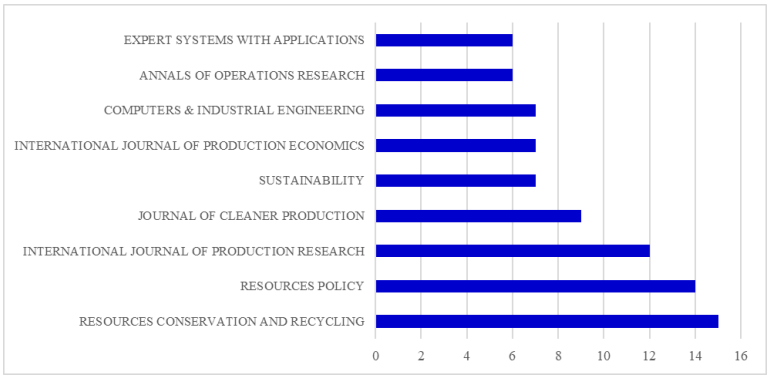

Fig. 4. Most publications publishing articles in the field of mining supply chain

Table 3. Articles with more than 100 citations in the field of mining supply chain

Cited by	Year	Article titles	Reference
254	2008	A hybrid approach to supplier selection for the maintenance of a competitive supply chain	[64]
152	2010	Sales forecasts in clothing industry: The key success factor of the supply chain management	[65]
401	2011	The supply chain of CO2 emissions	[66]
122	2012	A supply chain based assessment of water issues in the coal industry in China	[47]
219	2013	Barriers to green supply chain management in Indian mining industries: a graph theoretic approach	[67]
186	2013	Role of behavioural factors in green supply chain management implementation in Indian mining industries	[68]
139	2014	The impact of supply chain analytics on operational performance: a resource-based view	[69]
102	2014	Mining logistics data to assure the quality in a sustainable food supply chain: A case in the red wine industry	[70]
186	2015	An analysis of interactions among critical success factors to implement green supply chain management towards sustainability: An Indian perspective	[71]
106	2015	Green supply chain practices evaluation in the mining industry using a joint rough sets and fuzzy TOPSIS methodology	[72]
137	2016	Assessing green supply chain practices in the Ghanaian mining industry: A framework and evaluation	[73]
125	2016	Investigation of the influential strength of factors on adoption of green supply chain management practices: An Indian mining scenario	[74]
167	2017	Corporate investments in supply chain sustainability: Selecting instruments in the agri-food industry	[75]
140	2017	Food safety pre-warning system based on data mining for a sustainable food supply chain	[76]
334	2019	The case for recycling: Overview and challenges in the material supply chain for automotive li-ion batteries	[77]
115	2019	Supply risks of lithium-ion battery materials: An entire supply chain estimation	[78]
100	2019	China's domestic and foreign influence in the global cobalt supply chain	[79]
529	2020	Blockchain for Supply Chain Traceability: Business Requirements and Critical Success Factors	[80]
379	2020	Big data analytics as an operational excellence approach to enhance sustainable supply chain performance	[81]
199	2020	Identifying supply risks by mapping the cobalt supply chain	[51]
101	2020	A data mining-based framework for supply chain risk management	[82]

3-3- Keyword and Author Network Analysis

Fig. 5a illustrates keyword clustering, revealing four core clusters:

- Green Cluster: management, AI, big data, blockchain (recent topics)
- Pink Cluster: sustainability, circular economy, resilience
- Purple Cluster: traditional SCM topics (older studies)
- Yellow Cluster: optimization, modeling, inventory (as tools across clusters)

The yellow cluster acts as a buffer between the other clusters and is connected to all the clusters; this is due to the type of cluster which is more related to optimization, models, decision sciences, etc. The other clusters which consist of a core and are related to keywords around it. This shows that all the studies are summarized in these keywords which themselves fall into four clusters.

Fig. 5b shows the temporal distribution of these clusters, confirming that emerging technologies dominate recent publications. Emerging keywords are highlighted in yellow in this figure, most of which indicate that studies in this field since 2023 have tended to use intelligent methods in analyses, dynamic assessments, new technologies, etc. Before 2023, keywords revolved around uncertainties, risks, resilience, etc. Considering this, it can be said that the present studies are conceptually related to these issues and have moved towards the use and discovery of new intelligent methods in terms of analysis.

Fig. 6a and 6b represent the author co-authorship network. Fig. 7 lists top contributing authors, with Akhilesh Barve leading with five publications. This author has worked on 5 of his most cited articles in the field of mineral supply chains.

Fig. 8 presents the top 15 countries by publication volume—China (55), USA (33), and India (21) lead the field.

Fig. 9 illustrates the contribution of each research area. Environmental and process-related studies dominate (35.7% and 33%, respectively), followed by operational (26.6%), managerial (20.4%), and sustainability-focused research (13.8%).

3-4- The status of various mineral resources in the literature

The supply chain in the mining industry varies in its study objectives due to the high diversity of minerals and the unique characteristics of each. By examining the resources obtained from systematic searches and analyzing abstracts and results, comprehensive information regarding the supply chains of various minerals was gathered, as presented in Table 4.

Notably, a significant number of studies focused on the supply chain of iron. This prevalence can be attributed to the nature of this metal and its interactions with other minerals and metals, resulting in some overlap among the articles. In these studies, objectives such as risk analysis and resilience, supply and

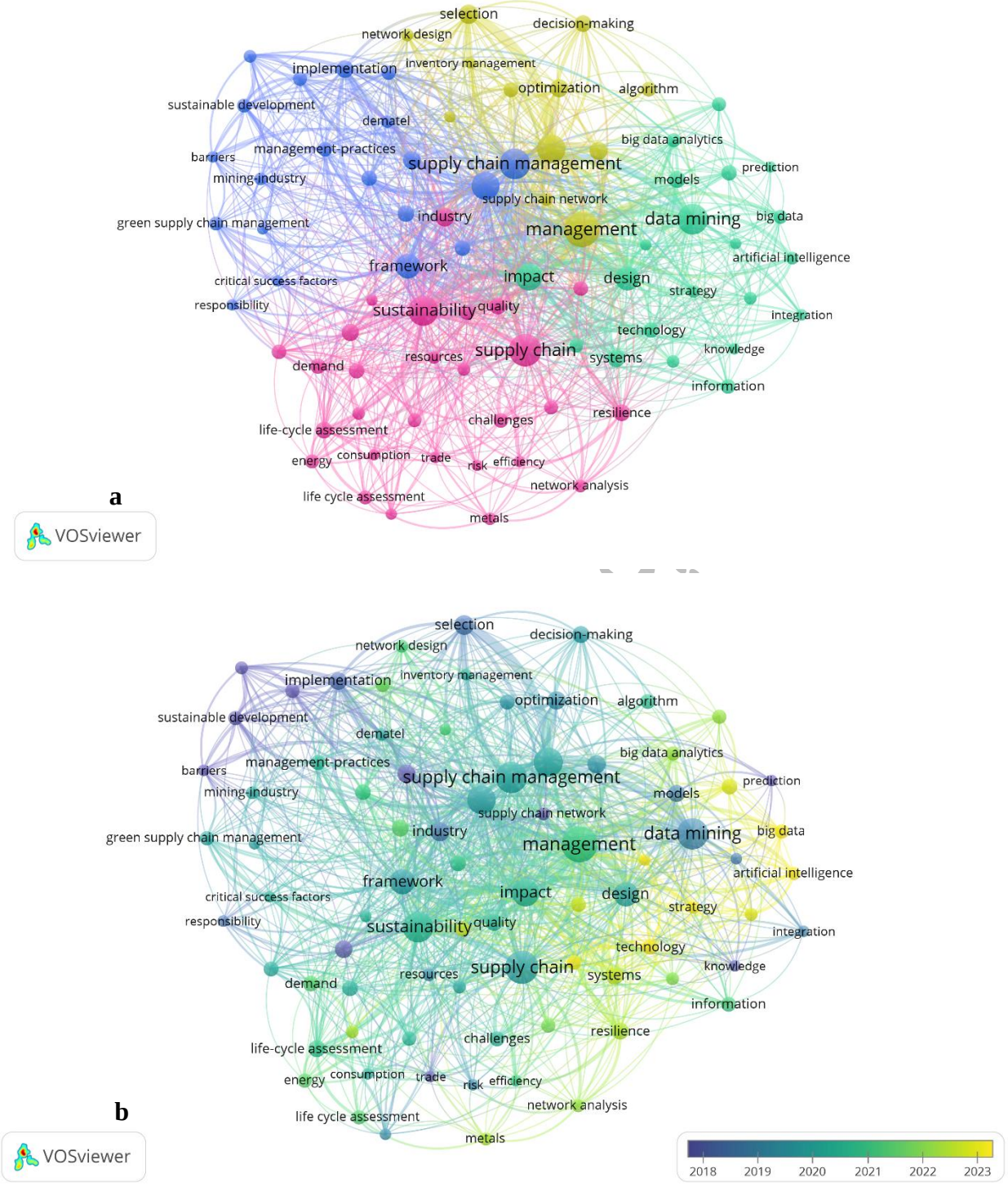

Fig. 5. The keyword co-occurrence network.

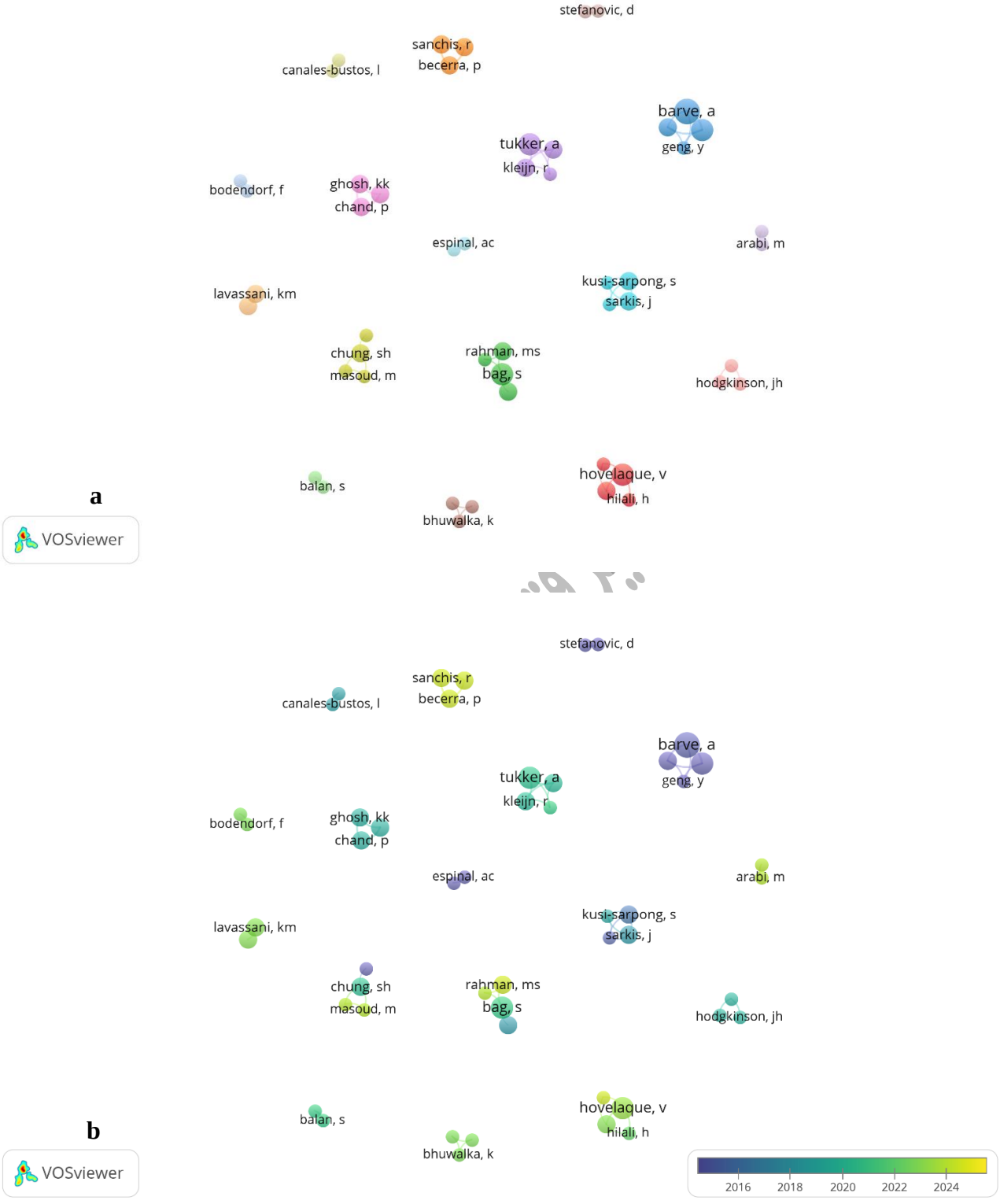

Fig. 6. The authurs co-occurrence network.

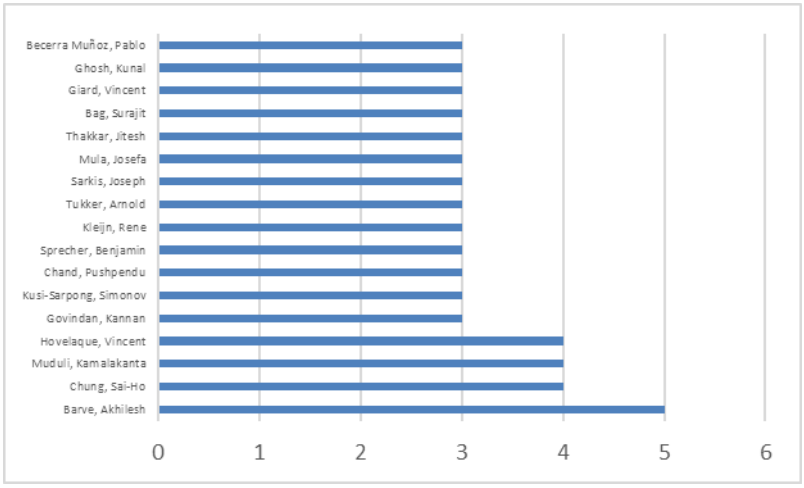

Fig. 7. The most productive and prominent authors in mining supply chain.

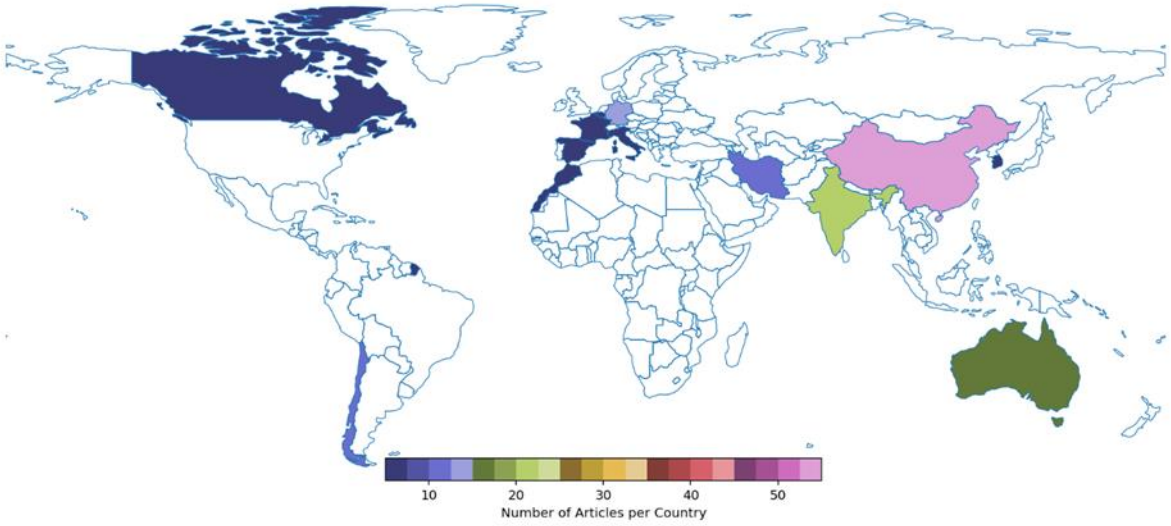

Fig. 8. Share of each country in published articles

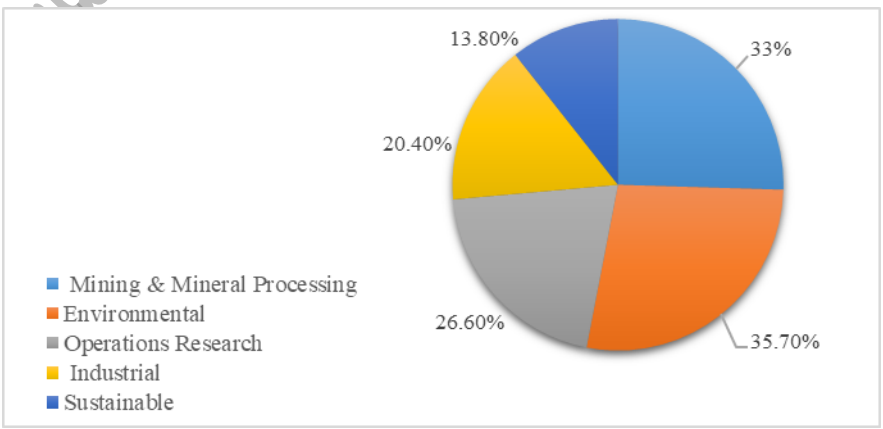

Fig. 9. The contribution of each research area

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The supply chain of coal was another area of focus, where, in addition to resilience, environmental assessments, optimization, and efficiency were identified as primary study objectives. Regarding precious metals like gold, as well as cobalt and rare earth elements, the objectives of these studies were closely aligned with the inherent nature of their respective supply chains. For instance, in the gold supply chain, economic modeling and analysis of raw material flows are specific to this chain. Furthermore, challenges related to recycling and circular economy considerations were unique aspects of the supply chain for rare earth elements.

Minerals	Numbers	Objective
Iron	112	Review of sustainable management methods
		Risk and resilience analysis
		Digital transformation and technology
		Market and demand analysis
		Optimal resource management
		Sustainable development
Coal	22	Efficiency and Optimization
		Supply Chain Resilience
		Environmental Impact Assessment
		Decentralized Decision-Making
		Resource Management and Sustainability
		Challenges and Strategic Planning
		Technological Integration
Gold	5	Stakeholder Analysis in Mercury Supply Chain
		Integration of ICT in Gold Mining
		Impact of Supply Chain Due Diligence
		Material Flow Analysis and Economic Modeling
cobalt	18	Cobalt Supply Chain Vulnerabilities
		China's Influence on Cobalt Supply
		Environmental Impacts of Mining
		Supply Chain Constraints for Battery Materials
		Traceability and Ethical Sourcing
		Impact of Child Labor in Cobalt Mining
		Recycling and Circular Economy
		Decarbonization Strategies
Rare Earth	7	Dysprosium Demand and Supply Dynamics
		Trade and Recycling Challenges
		System Dynamics Modeling for Policy Evaluation
		Circular Economy and E-Waste Recovery
		Mitigation Strategies for Supply Chain Risks
		Global Cooperation and Diversification
		Impact of Chinese Policies on Supply Chain

4- Conclusion

This bibliometric review provides a comprehensive and structured analysis of the academic literature on mining supply chain management (MSCM), based on 152 peer-reviewed articles published between 2003 and 2025. Through the use of bibliometric tools and visual mapping techniques, the study identifies key trends, influential authors, high-impact journals, and thematic clusters that define the intellectual structure of the field.

The literature is categorized into nine major themes, encompassing environmental protection, logistics, inventory control, network design, capacity planning, efficiency evaluation, risk control, production scheduling, and economic issues. These themes are further grouped into three overarching domains—mining operations, supply chain processes, and economic considerations—demonstrating the interdisciplinary nature of MSCM. Leading journals in the field include Resources, Conservation & Recycling, Journal of Cleaner Production, and International Journal of Production Research.

The findings reveal a significant shift in recent years toward research on sustainability, circular economy practices, risk mitigation, and digital transformation. This reflects the growing importance of resilience and environmental responsibility in the mining sector. The analysis of co-authorship and keyword networks also suggests increasing collaboration among researchers across disciplines and regions.

By categorizing the subject matter in this context, it is possible to understand the problems and complexities across the mineral supply chain. For example, protecting the environment across the supply chain falls under the mining sub-discipline, but protecting the supply chain from environmental risks falls under the economics sub-discipline; this helps industrial managers understand their organization’s issues and set goals for in-house research.

Despite this progress, the review identifies several underexplored areas that warrant further investigation, including ESG-oriented supplier selection, the application of

advanced data analytics, and empirical validation of risk management models. Addressing these gaps requires interdisciplinary approaches that integrate engineering, management, policy, and environmental science.

Ultimately, this study not only maps the current state of MSCM research but also offers a roadmap for future studies aimed at developing more adaptive, efficient, and sustainable mining supply chains. It serves as a valuable reference for scholars, practitioners, and policymakers committed to advancing knowledge and practice in one of the world's most complex and impactful industrial systems.

This study outlines the mining supply chain research agenda and serves as a tool to help researchers access the literature database and understand the research gaps in their topic. It also helps the reader identify the literature of their topic by collecting systematic search methods in review studies.

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