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The Role of AI in Digital Supply Chain Transformation in The Era of Trade Wars: Bibliometrics Analysis 2021-2025

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Abstract

Purpose – This study aims to examine the development, structure, and research focus of the literature on supply chain transformation in the context of global disruptions

Methodology – This research applies a quantitative bibliometric analysis based on data retrieved from the Scopus database and VOSviewer to identify publication trends, citation patterns, international collaboration, and thematic clusters

Findings – The results indicate a steady growth in publications, highlighting the increasing academic attention to supply chain resilience and operational risk management. Keyword co-occurrence analysis reveals four dominant research themes

Research limitations – This study only used data from the Scopus database in the period 2021-2025

Practical implications – Highlight the importance of combining operational strategies with digital capabilities, expanding supplier sources, and increasing the flexibility of supply chain networks to address ongoing uncertainty.

Introduction

The development of digital technology has revolutionized the way companies manage supply chain activities. Digital supply chains are no longer simply traditional linear systems, but rather integrated networks that utilize real-time data, automation, and artificial intelligence (AI) to accelerate decision-making and respond to global market dynamics. Empirical studies show that the adoption of digital technologies, particularly AI, improves operational efficiency by enhancing demand planning, inventory control, and coordination across operational functions within the supply chain. In this context, the integration of AI solutions strengthens companies' ability to identify operational weaknesses and respond to disruptions more quickly and accurately, especially when facing volatile and competitive market conditions (Mohsen, 2023). The integration of AI into supply chain management has also been shown to contribute to better visibility, accurate demand forecasting, and data-driven decision-making, thereby reducing uncertainty in logistics and distribution operations. In empirical studies, technological innovations, including AI, play a significant mediating role in improving digital supply chain

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performance through more sophisticated data processing and more precise predictions compared to traditional approaches (Dalain et al., 2025a).

However, digital transformation through AI is not just about improving operational efficiency; this technology also strengthens supply chain resilience in the face of various global disruptions. Contemporary research shows that the use of AI in supply chains not only automates routine tasks but also enhances organizations' ability to predict disruptions, proactively assess risks, and redesign distribution networks if conditions suddenly change. These findings underscore the importance of AI as a key operational strategy in navigating uncertain business environments (Qosidah & Wardi, 2025).

In the context of geopolitical tensions such as trade wars, companies face additional risks in the form of tariff fluctuations, trade barriers, and disruptions to raw material supplies. Although the academic literature on the role of AI in supply chains is relatively developed, some existing literature still focuses on the general use of this technology without explicitly linking it to the context of trade wars or geopolitical instability. A more focused literature review would help clarify the extent to which AI contributes to the development of operational strategies and adaptation in the face of global pressures such as the current trade conflict (Mohsen, 2023).

Therefore, this study conducted a bibliometric review of articles discussing the role of AI in digital supply chain transformation during trade wars. Using this approach, this study aims to understand trends in the number of published articles, how collaboration between academics is progressing, issues frequently discussed in scientific discussions, and potential future research directions. The bibliometric approach helps clarify how the topic of AI in supply chains is evolving, both numerically and by topic, thereby enhancing academic understanding and providing useful information for practitioners in developing operational strategies that can adapt to global challenges.

Literature Review

Digital Supply Chain Transformation in Operational Management

The development of digital technology is transforming the way companies manage their supply chains. The concept of a digital supply chain describes a supply chain that is connected end-to-end through real-time data, IoT, ERP systems, analytics, and cross-partner collaboration platforms. Digital supply chains and intelligent operations make the flow of information, materials, and finances more transparent, measurable, and responsive, enabling faster, data-driven operational decision-making (Ivanov et al., 2021).

Another study showed that technological innovation, particularly artificial intelligence, advanced analytics, and automation, is positively associated with the adaptability and efficiency of digital supply chains (Dalain et al., 2025b). They found that artificial intelligence and digital supply chain systems enhance a company's ability to adapt to environmental changes, while operational efficiency also drives the use of AI in decision-making processes. The digital supply chain also emphasizes that digitalization is not simply about adopting technology, but rather about transforming the overall way operations work, from planning to distribution. Digital supply chain transformation represents a shift from reactive to more data-driven and real-time operational decision-making. In this context, an organization's ability to integrate data from various functions such as planning, procurement, production, and logistics becomes crucial. This helps improve visibility, coordination, and speed in responding to changes in the business

environment. According to recent literature, digitalization forms the basis for planning across all processes, enabling more flexible operational performance management, especially in times of increased uncertainty and rapid decision-making.

The Role of AI in Supply Chain Management and Operations

Recent literature consistently describes AI as a key driver in digital supply chain transformation, with AI being used in four key areas of supply chain management: resilience, process optimization, sustainability, and managing implementation challenges (Teixeira et al., 2025). AI helps predict demand, plan capacity, schedule production, manage inventory, design distribution routes, and assist in strategic decision-making. AI is transforming supply chain operations through its ability to process big data, improve decision speed and accuracy, and support integration with other technologies such as 5G and the Internet of Things in the context of digital operations (Culot et al., 2024). The development of AI from Industry 4.0 to Industry 6.0 is making supply chain processes faster, more accurate, and more coordinated, for example through process automation with robots, computer vision, and machine learning that are directly linked to company operational decisions (Samuels, 2025). Furthermore, several studies emphasize that AI not only impacts efficiency but also the capability and capacity of the supply chain. A systematic review in the context of emerging markets found that AI applications can improve companies' ability to respond to changing demand, manage capacity, and accelerate the flow of goods, although its adoption is still hampered by limited digital infrastructure and competencies.

AI for Resilience: From Intrusion Detection to Network Redesign

Artificial intelligence (AI) is increasingly recognized as a critical tool for enhancing supply chain resilience, particularly in detecting disruptions and flexibly responding to uncertainty. Using technologies such as machine learning, predictive analytics, and real-time data processing, AI helps companies detect potential disruptions early, estimate their impact on operations, and support faster and more informed decision-making. Combining AI with digital twins plays a crucial role in strengthening the supply chain's ability to withstand and recover from major disruptions (Bakopoulos et al., 2024). In addition to helping detect and mitigate risks, AI also aids network redesign by simulating various scenarios and optimizing supply chain network structures. Bibliometric research by Belu & Marinoiu (2025) indicates that resilience, risk management, and network redesign are key topics in AI research in supply chain management, reflecting a shift in focus from efficiency to operational resilience. Similar findings are also found by those who emphasize that AI enables strategic adjustments in supplier selection, distribution channels, and storage locations to address systemic and recurring disruptions (Bigliardi et al., 2025).

Research Methods

This study uses a descriptive quantitative approach with a bibliometric review method that follows the PRISMA 2020 guidelines to map the development of literature on the role of artificial intelligence (AI) in digital supply chain transformation in the era of trade wars.

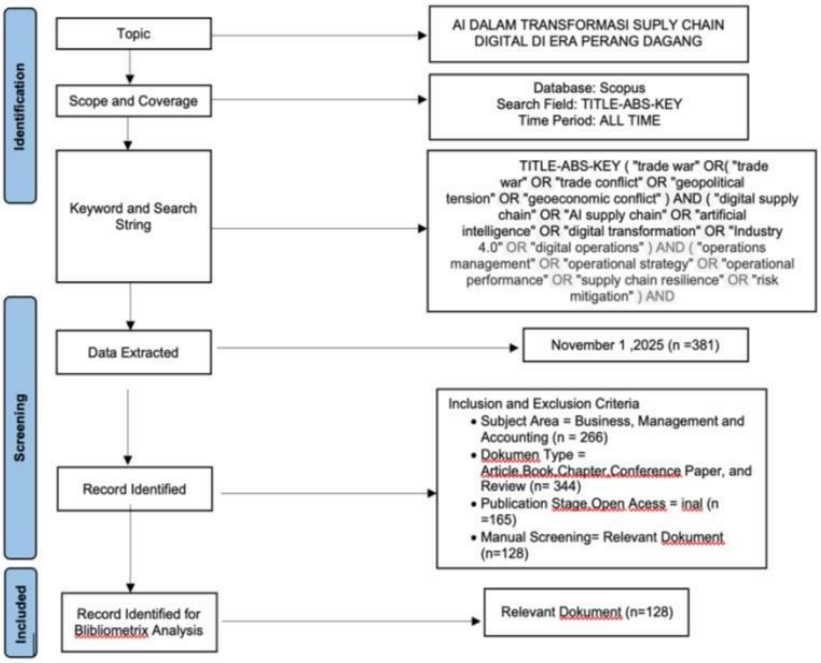

Figure 1 Prisma Flow Diagram

This study employed a bibliometric review method with a literature selection process following the PRISMA guidelines. The data search was conducted through the Scopus database in the TITLE-ABS-KEY columns over a year-long time span, using keywords representing trade wars and geopolitical tensions, artificial intelligence, digital supply chain transformation, and operational management. The search process, conducted on November 1, 2025, yielded 98 initial documents. Documents were then selected based on the Business, Management, and accounting field of study, document type (article, review, conference paper, and book chapter), and publication stage in open access journals. The final stage involved manual screening of titles and abstracts to assess research relevance, resulting in 75 documents used as the final sample in the bibliometric analysis.

Results and Discussion

This section presents and discusses the main findings from a bibliometric analysis of literature related to supply chain transformation and operational management in the context of global disruption. The analysis focuses on key information, including publication characteristics, citation trends, cross-country collaborations, and thematic keyword clusters. The results provide an overview of the direction of research development, the level of scholarly influence, and the dominant focus of studies shaping academic discourse in this field. The following Table 1 presents the processed indicator results.

Based on citation metrics, the 75 articles analyzed during the 2021–2025 period generated 2,439 citations, with an average of 609.75 citations per year. The average citation rate per article of 32.52 indicates that publications in this field have a relatively high level of scientific impact. The h-index of 20 and g-index of 49 indicate that several articles consistently receive high citations and contribute significantly to the development of literature. Furthermore, more than half of the articles have received at least 10 citations, indicating that this research topic is not only growing quantitatively but also has strong relevance and influence within the academic community. Overall, these metrics reflect that the study of supply chain transformation and

operations management in the context of global disruption is an active and impactful research area.

Table 1 Main Information Data Findings

Indicator	Value
Publication Year	2021-2025
Citation Year	2021-2025
Number of Articles (Papers)	75
Number of Citations	2,439
Average Citation per Year	609.75
Average Citation per Article	32.52
Average Citation per Author	767.07
Average Article per Author	27.03
Average Author per Article	3.52
h-index	20
g-index	49
h-index normalization (h, norm)	14
Yearly h-index (h, annual)	3.25
hA-index	18

Number of Publications

Based on the results of Scopus' analysis of 128 selected documents, the number of articles discussing AI in digital supply chain transformation and operational management showed a consistent and significant increase from 2021 to 2026. Based on the data, the number of publications shows a consistent upward trend from 2021 to 2025. In 2021 there were 4 documents, then it increased sharply in 2022 to 12 documents. The upward trend continued in 2023 (15 documents) and 2024 (17 documents), until it peaked in 2025 with 26 documents. This increase reflects the growing academic attention to the topic being researched. A drastic decline in 2026 with only one document cannot be interpreted as a decrease in research interest but is most likely due to period limitations and an unfinished indexation process.

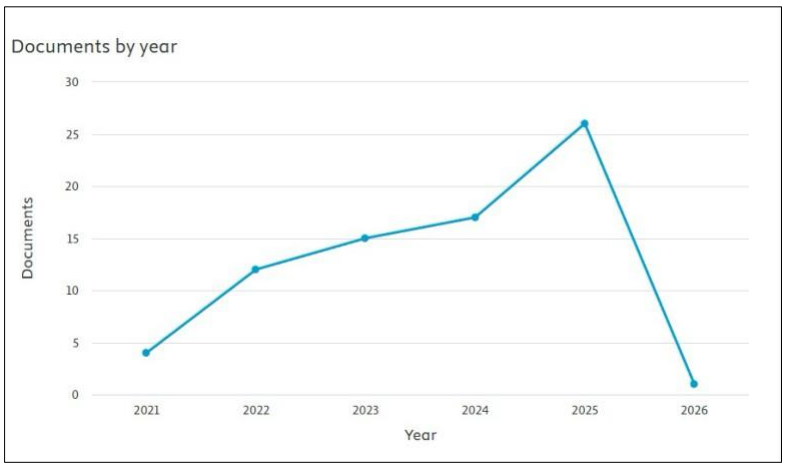

Figure 2 Publication trends from year to year

The largest increase occurred between 2024 and 2025, indicating that this topic is not a stagnant trend, but rather a rapidly growing area of research. This decline is likely influenced by rising tensions between countries and trade wars, as well as the accelerated adoption of AI as a strategy to improve supply chain resilience. Thus, these findings reinforce the relevance of this

bibliometric research and demonstrate that studies related to AI in operations management are not merely theoretical but also address real-world challenges facing the world.

Citation Number Trend

Citation trend analysis is used to identify the influence and contribution of key publications in developing research related to supply chain transformation and operational management. Citation patterns reflect how a topic has gained academic attention over time and indicate shifts in research focuses deemed most relevant by the scientific community. The following articles, with the highest citation rates, illustrate the direction of the literature and key themes shaping the research discourse in the field of digital supply chains and artificial intelligence.

Table 2 Citation Trends

Authors	Article Title	Journal	Published Year	Number of Citation
Chowdhury, P.; Paul, S.K.; Kaisar, S.; Moktadir, M.A.	Covid-19 pandemic related supply chain studies: A systematic review	Transportation Research Part E: Logistic and Transportation Review	2021	793
Modgil, S.; Singh, R.K.; Hannibal, C.	Artificial intelligence for supply chain resilience: learning from COVID-19	International Journal of Logistic Management	2022	376
Rejeb, A.; Keogh, J.G.; Zailani, S.; Treiblmaier, H.; Rejeb, K.	Blockchain Technology in The Food Industry: A Review of Potentials, Challenges and Future Research Directions	Logistics	2020	225
Bednarski, L.; Roscoe, S.; Blome, C.; Schleper, M. C.	Geopolitical disruptions in global supply chains: a state-of-the-art literature review	Production Planning & Control	2025	117
Chatterjee, S.; Chaudhuri, R.; Shah, M.; Maheswari, P.	Big data driven innovation for sustaining SME supply chain operation in post COVID-19 scenario: Moderating role of SME technology leadership	Computers & Industrial Engineering	2022	117
Tarigan, Z.J.H.; Siagian, H.; Jie, F.	Impact of internal integration, supply chain partnership, supply chain agility, and supply chain resilience on sustainable advantage	Sustainability (Switzerland)	2021	116

Based on the table of articles with the highest number of citations, it can be seen that the most influential literature in the field of operational management and supply chains is dominated by studies discussing global disruptions, particularly the COVID-19 pandemic. The article "Supply chain studies related to the COVID-19 pandemic: A systematic review" (2021) ranks first with a significantly higher number of citations than other articles, demonstrating its role as a key reference in understanding the impact of the global crisis on supply chains. The article "Artificial intelligence for supply chain resilience: learning from COVID-19" (2022) ranks second and marks a shift in research focus to the use of artificial intelligence (AI) as an operational strategy to enhance supply chain resilience. The high number of citations in these

articles indicates increasing academic attention to technology-based solutions in response to uncertain business environments.

Furthermore, the presence of the article "Blockchain Technology in the Food Industry" (2020) demonstrates that other digital technologies, such as blockchain, have also become important topics before and during the pandemic in an effort to improve supply chain transparency and reliability. Meanwhile, the article "Geopolitical Disruption in Global Supply Chains" (2025) reflects a recent shift in the literature toward geopolitical tensions and trade wars as new sources of disruption impacting global operational strategies. Overall, these citation patterns illustrate the evolution of research from a focus on the pandemic crisis to the integration of digital technologies and greater attention to geopolitical risks. These findings confirm that operational and supply chain management continues to adapt to the changing global context, with digital technology and AI as key elements in building long-term resilience.

Countries Collaboration

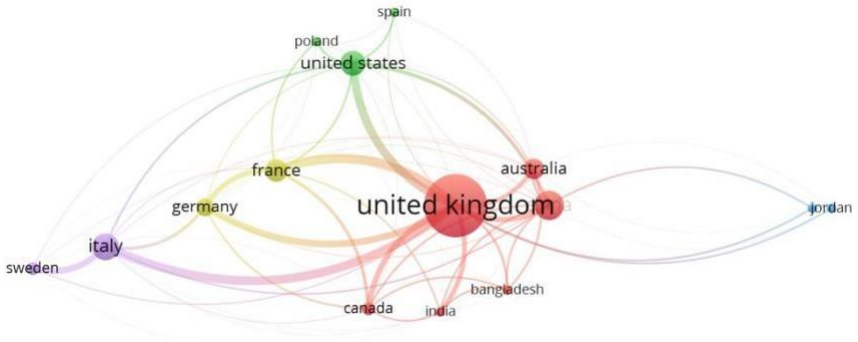

Figure 3 Countries Bibliographic Coupling
(Source: Processed Data, 2025)

Based on the cross-country collaboration network, the UK emerged as a major hub for research on AI and digital supply chain transformation. This is evident in the size of the largest nodes and the number of connections with other countries. Of the 43 countries identified in the dataset, only 16 met the inclusion threshold of at least three documents per country. This finding suggests that research contributions in this area remain concentrated in a small number of countries, while most other countries make relatively limited contributions to the overall literature.

These results are supported by quantitative data, with the United Kingdom having the highest number of documents (28), the highest number of citations (1,092), and the highest link strength (373), indicating a very strong level of international collaboration. Other developed countries such as the United States, France, Italy, and Australia also play a significant role in this collaborative network. The United States has a high number of citations (296) with significant cross-border connections, while France and Italy demonstrate strategic positions as hubs within the European cluster. Australia is relatively central with a high number of citations (872), despite having fewer documents, indicating a strong impact of publications. Interestingly, some developing countries such as India and Bangladesh show relatively high numbers of citations compared to the number of documents. For example, Bangladesh has only three documents but has received 811 citations, indicating the presence of highly influential

articles despite their limited contribution to the number of documents. A similar pattern is observed in India with 394 citations from three documents, indicating a significant intellectual contribution to the global network.

Verify selected countries

Selected	Country	Documents	Citations	Total link strength
☑	united kingdom	28	1092	373
☑	china	11	69	133
☑	italy	10	117	150
☑	united states	9	296	137
☑	france	8	187	150
☑	australia	7	872	67
☑	germany	6	244	117
☑	canada	4	155	100
☑	sweden	4	1	54
☑	bangladesh	3	811	57
☑	india	3	394	73
☑	spain	3	64	21
☑	poland	3	35	33
☑	malaysia	3	29	34
☑	jordan	3	17	23
☑	indonesia	3	4	0

Figure 4 Country Collaboration in Publication
(Source: Processed Data, 2025)

In contrast, countries such as China, Malaysia, Jordan, and Indonesia have relatively few documents and low total link strength, indicating limited engagement in international collaboration on this topic. Indonesia, in particular, despite having three documents, has a very low number of citations and link strength, indicating significant potential for increasing international collaboration and research visibility in the areas of AI-based operational management and digital supply chains.

Research Focus

The current research focus is on how organizations build supply chain resilience through operational management and risk management strategies, with the primary context being global disruptions shifting from pandemics to trade wars and geopolitical tensions.

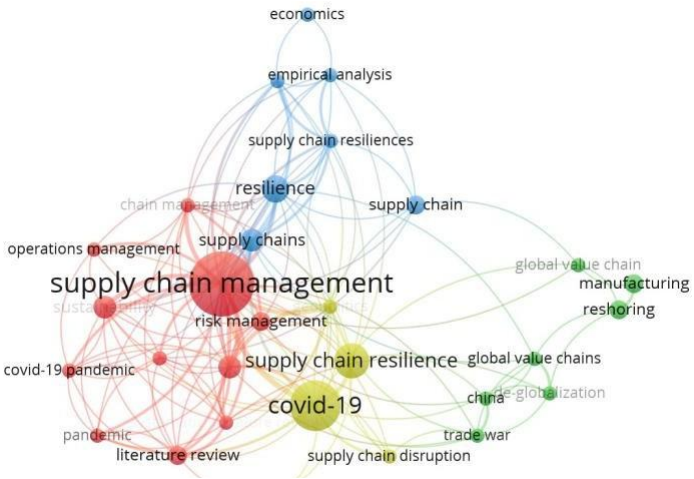

Figure 5 Keyword Visualitation
(Source: Processed Data, 2025)

Based on the results of keyword co-occurrence analysis, of the 471 keywords identified in the dataset, only 30 met the analysis threshold, namely having at least three occurrences. This indicates that although the research topic is quite broad and diverse, the research focus tends to concentrate on a small number of core keywords that are frequently used repeatedly in

literature. Network visualization shows that "supply chain management" is the most dominant keyword and acts as the center of the network, with strong links to other keywords such as supply chain resilience, risk management, operations management, and sustainability. This dominance indicates that supply chain management is a key foundation in discussing various issues of disruption and operational strategy.

Furthermore, the keyword "COVID-19" formed a highly visible cluster and was closely related to terms such as supply chain disruption, pandemic, literature review, and dynamic capabilities. This suggests that the COVID-19 pandemic is a key context, driving increased research on supply chain resilience and adaptation. Other emerging clusters link supply chain resilience to global value chains, trade wars, deglobalization, domestic production relocation, and manufacturing. These relationships reflect a shift in research focus from pandemic-induced disruptions to geopolitical tensions and trade wars as new sources of risk in global supply chains.

Meanwhile, the presence of keywords such as empirical and economic analysis indicates that the research approach is not merely conceptual or literature review but also supported by empirical analysis to understand the impact of global disruptions on supply chain performance and strategy. Overall, this co-occurrence pattern illustrates the evolution of research from a focus on the pandemic crisis to a broader focus on supply chain resilience, risk management, and the implications of trade wars and global value chain restructuring. This finding confirms that issues of digital supply chain transformation and operational management exist within the context of interconnected global disruptions.

In this study, bibliographic grouping of keywords was also carried out to identify keyword clusters that have a similar literature focus and are frequently used together in published articles.

Table 3 VosViewer Cluster Result

Cluster	Number of Item	Main Theme	Main Keywords
1	11	Supply Chain Management & Pandemic	chain management, supply chain management, operations management, risk management, covid-19 pandemic, pandemic, supply chain disruptions, sustainability, literature review, systematic review
2	7	Global Value Chains & Trade Wars	china, global value chain, global value chains, trade war, de-globalization, reshoring, manufacturing
3	7	Empirical Analysis & Economic Perspective	economics, empirical analysis, innovation, resilience, supply chain, supply chain resiliences, supply chains
4	5	Dynamic & Geopolitical Capabilities	covid-19, dynamic capabilities, geopolitics, supply chain disruption, supply chain resilience

(Source: Processed Data, 2025)

The results of the keyword co-occurrence analysis grouped 30 keywords into four main clusters reflecting the research focus in the field of supply chain management. The first cluster is dominated by studies on supply chain management and disruptions due to the COVID-19 pandemic, primarily through literature reviews and risk management approaches. The second cluster shows a shift in focus to global value chains, trade wars, and deglobalization, highlighting the restructuring of global production networks in response to geopolitical

tensions. The third cluster represents empirical and economic approaches to analyzing supply chain resilience and innovation, demonstrating increasing methodological maturity of the research. Meanwhile, the fourth cluster emphasizes the role of dynamic capabilities and geopolitical factors in addressing supply chain disruptions, linking the context of the pandemic and global conflict to organizational adaptive capacity. Overall, these clusters demonstrate the evolution of research from pandemic crisis responses to long-term strategic issues in global supply chain resilience and transformation.

Research Implication

The implications of this research suggest that changes in supply chain management and operations are not only related to efficiency gains but also represent a long-term strategy for building resilience in the face of ongoing global disruptions. The results of the bibliometric analysis confirm that supply chain resilience, risk management, and organizational adaptability have become a key focus of research, especially after the research context shifted from the impact of the COVID-19 pandemic to trade wars and tensions between countries. For practitioners, these findings demonstrate the importance of combining operational strategies with digital capabilities, expanding supplier sources, and increasing the flexibility of supply chain networks to address ongoing uncertainty. Furthermore, for academics and policymakers, this research opens up opportunities to expand empirical research to various countries and encourage international collaboration, particularly involving developing countries, to gain a broader and more relevant understanding of global supply chain dynamics.

Conclusion

This study concludes that the study of supply chain transformation and operational management is evolving rapidly in response to increasingly complex global disruptions, particularly the COVID-19 pandemic and continuing geopolitical tensions and trade wars. Bibliometric analysis shows a consistent increase in publications through 2025, which indicates that the issue of supply chain resilience and adaptive operational strategies has become a major concern in contemporary operational management literature.

The results of the mapping of themes and keyword clusters revealed that the focus of the initial research was dominated by studies on supply chain disruptions due to the pandemic, risk management, and short-term operational responses. Over time, research attention shifted to more structural and long-term issues, such as global value chain restructuring, de-globalization, and trade wars. This shift shows that global disruption is no longer understood as a temporary event, but rather as a business environment condition that demands fundamental changes in supply chain design and management.

In this context, the role of artificial intelligence (AI) in literature has emerged as a strategic support for operational management transformation, especially through its association with the concepts of supply chain resilience, risk management, and dynamic capabilities. Although AI is not yet the most dominant keyword, bibliometric findings show that AI is increasingly positioned as a tool to improve data analysis capabilities, support operational decision-making, and strengthen adaptive responses to global uncertainty. Thus, the role of AI in this study is enabling and integrative, not as a major technical focus, but as part of a broader operational strategy. Overall, this study confirms that supply chain transformation and operational management are long-term strategic agendas that place resilience and adaptability

as key elements. The role of AI in this context opens up opportunities for further research, particularly empirical studies that examine how AI adoption significantly affects operational performance and supply chain resilience in different sectors and country contexts. Thus, this study not only maps the development of existing literature but also provides direction for the development of further research that is more applicable and evidence based.

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