ARTIFICIAL INTELLIGENCE AND SUPPLY CHAIN MANAGEMENT: A BIBLIOMETRIC EXPLORATION OF IMPACTS ON OPERATIONAL PERFORMANCE

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How to cite this paper: Ghouati, S., Rizi, L., Oulfarsi, S., & El Amri, A. (2026). Artificial intelligence and supply chain management: A bibliometric exploration of impacts on operational performance. *Business Performance Review, 4*(1), 118–130. https://doi.org/10.22495/bprv4i1p10

ISSN Online: 3005-6829
ISSN Print: 3005-6810

Received: 20.10.2025
Revised: 13.02.2026; 12.03.2026
Accepted: 23.03.2026

JEL Classification: C88, M11, O33
DOI: 10.22495/bprv4i1p10

Abstract

Artificial intelligence (AI) has emerged as a structuring technology for the transformation of supply chains, profoundly reshaping operational models and performance logics. By integrating predictive, cognitive, and adaptive capabilities, AI strengthens responsiveness, visibility, and resilience in logistics chains operating in complex and uncertain environments (Ivanov, 2024; Choi et al., 2023). Yet, despite the explosion of scientific research on this topic over the past decade, the literature remains fragmented and dispersed across several disciplines. This article offers a bibliometric analysis of publications dedicated to AI in supply chain management (SCM) and its impact on operational performance (OP) over the period 2010–2024. Based on data from Scopus and Web of Science (WoS), the study identifies research trends, the most influential authors and countries, as well as emerging themes. Three main axes are revealed: the predictive optimization of flows, the integration of AI with complementary technologies such as blockchain to improve traceability and sustainability, and the role of AI in organizational resilience (Mukherjee et al., 2024). Beyond this mapping, the article demonstrates that AI, far from being a mere technical tool, has become a strategic resource that redefines governance models and the very notion of performance.

Keywords: Artificial Intelligence, AI, Supply Chain Management, SCM, Operational Performance, Supply Chain Capabilities, Resilience, Sustainability

Authors' individual contribution: Conceptualization — S.G.; Methodology — S.G.; Software — L.R.; Validation — S.O. and A.E.A.; Investigation — S.G. and L.R.; Resources — S.G.; Data Curation — S.G.; Writing — Original Draft — L.R.; Writing — Review & Editing — S.G. and L.R.; Visualization — S.O. and A.E.A.; Supervision — S.O. and A.E.A.; Project Administration — S.G., S.O., and A.E.A.

Declaration of conflicting interests: The Authors declare that there is no conflict of interest.

1. INTRODUCTION

Digital transformation has profoundly disrupted the functioning of global supply chains, and artificial intelligence (AI) today constitutes one of its cornerstones. Initially perceived as an experimental field reserved for computer science researchers and military applications, AI has gradually penetrated industrial, logistics, and commercial sectors. Its integration into supply chains responds to the growing need to process massive volumes of data, manage uncertain environments, and improve real-time decision-making. Facing market volatility, recurring health and geopolitical crises, and growing consumer expectations for personalization and sustainability, companies can no longer depend on traditional optimization models alone. They are turning to AI not only to enhance efficiency and resilience but also to rethink the operational performance indicators that structure their activities (Choi et al., 2023; Dubey et al., 2021; Ivanov & Dolgui, 2021).

One of the most striking aspects of the recent evolution of research is the exponential growth of publications addressing AI in supply chain management (SCM). Several bibliometric analyses confirm this trend. Rana and Daultani (2023) identify a shift in scientific concerns toward digital transformation and AI, particularly in top-tier engineering and management journals. Belu and Marinoiu (2025), in a recent bibliometric analysis of 400 articles, confirm that dominant terms have gradually shifted from "optimization" and "logistics" to "resilience", "sustainability", and "traceability". These studies highlight the central role of AI in redefining the field of logistics and organizational performance.

The integration of AI into supply chains is not limited to a technological issue. It also raises theoretical and strategic questions. According to the resource-based view (RBV) (Barney, 1991), AI can be considered a strategic asset generating sustainable competitive advantage, provided it is coherently embedded within organizational routines. Companies capable of transforming data into operational intelligence acquire a hard-to-imitate capability, resulting in measurable gains (Fosso Wamba, 2017; Queiroz & Fosso Wamba, 2019). However, as shown by Toorajipour et al. (2021), the benefits of AI vary significantly depending on context. This contingency perspective explains why some firms achieve substantial gains while others struggle to move beyond experimentation (Samuels, 2025).

At the same time, agency theory (Jensen & Meckling, 1976) sheds light on the role of AI in reducing information asymmetries and improving inter-organizational governance. By strengthening flow transparency and automating partner performance monitoring, AI helps reduce agency costs and establish a climate of trust (Naz et al., 2022). This trend is reflected in the growing prominence of terms such as "blockchain" and "transparency" in recent bibliometric analyses.

It is also essential to note that the notion of operational performance has evolved over time. While performance was historically measured through classical financial and logistics indicators (costs, lead times, productivity), new dimensions have emerged, such as resilience, sustainability, and social responsibility (Kaplan & Norton, 1996; Gunasekaran et al., 2017). AI acts both on traditional indicators — by reducing costs or improving forecast accuracy — and on these new dimensions, by fostering adaptability, traceability, and operational integrity. Several studies confirm that AI plays a decisive role in ensuring operational continuity in the face of global disruptions (Elufioye et al., 2024; Wankmüller & Reiner, 2020).

Finally, scientific development around AI in supply chains is marked by strong internationalization. The United States and China dominate academic output, but contributions from Europe and emerging countries — particularly India and certain African nations — are growing significantly (Riahi et al., 2021; Benatiya Andaloussi, 2024). This geographical diversity enriches global understanding of the phenomenon by incorporating perspectives from varied contexts.

Despite this abundance of research, the literature remains fragmented and dispersed across disciplines (management, engineering, computer science). Few studies provide a systematic bibliometric analysis explicitly linking AI, SCM, and operational performance, particularly within a theoretical framework simultaneously integrating the RBV, agency theory, and contingency theory. Moreover, while bibliometric analyses exist, they often stop at describing global trends without linking emerging themes (resilience, sustainability, transparency) to the contemporary redefinition of performance.

Our study is distinguished by its originality on three levels:

1. Integrative approach: It proposes a comprehensive mapping of the scientific field linking AI, supply chains, and operational performance, combining bibliometric analyses with management theories.
2. Temporal perspective: It covers a long period (2010–2024), allowing us to highlight structural evolutions before, during, and after the COVID-19 crisis.
3. International dimension: It identifies not only dominant countries and authors but also the growing contributions from emerging economies, still underexplored.

Thus, the proposed bibliometric analysis pursues a dual objective: to provide a precise mapping of the key actors and themes structuring this field, and to interpret these results through the lens of management theories in order to draw academic and practical implications. Three guiding questions structure the approach:

RQ1: How have publications on artificial intelligence and performance in supply chain management evolved since 2010?

RQ2: Who are the most influential authors and institutions in this field?

RQ3: What are the emerging themes and their theoretical and managerial implications?

Answering these questions takes on full meaning to better understand how AI is redefining the notion of operational performance, moving beyond the traditional logic of efficiency to integrate resilience and sustainability. The article thus proposes a structured framework, useful both for managers seeking to guide AI adoption and for researchers wishing to deepen the study of this rapidly expanding field.

The structure of this paper is as follows. Section 2 reviews the relevant literature and presents the theoretical framework. Section 3 details the research methodology, including the corpus construction and analytical techniques. Section 4 presents the results of the bibliometric analysis. Section 5 discusses these findings, integrating them with management theory and outlining implications. Finally, Section 6 provides a general conclusion, limitations, and avenues for future research.

2. LITERATURE REVIEW

The profound digital transformation of global industries, accelerated by recent disruptions, has positioned AI as a central force in reconfiguring SCM. This evolution is reflected in the academic literature, which has progressively shifted from viewing AI as a mere operational tool to recognizing it as a strategic resource capable of generating sustainable competitive advantage (Mikalef & Gupta, 2021). Contemporary research underscores a transition from early themes of "optimization" and "automation" toward more holistic concerns such as resilience, sustainability, and ethical governance within AI-enabled supply chains (Belu & Marinoiu, 2025). This paradigmatic shift necessitates an integrative theoretical lens to understand how technological potential translates into tangible performance outcomes.

This study's conceptual framework is built on three interconnected pillars that structure this complex relationship: AI, supply chain capabilities, and operational performance. This tripartite structure allows for a nuanced analysis that moves beyond deterministic views of technology adoption. It posits that AI's primary value lies not in its standalone implementation but in its capacity to enhance and reconfigure core organizational capabilities. These augmented capabilities, such as agility, visibility, and resilience, then serve as the critical mechanisms that drive a broadened, multidimensional conception of operational performance in modern, volatile environments (Wong et al., 2024; Kazancoglu et al., 2023).

The following sections define and elaborate on each pillar, drawing on foundational and recent literature to establish their specific roles and interdependencies, culminating in the proposed conceptual model (see Figure 1).

2.1. Artificial intelligence

Artificial intelligence is defined as the set of predictive, cognitive, and adaptive capacities that organizations mobilize to process large volumes of data and enhance decision quality. It encompasses technologies such as machine learning, deep learning, and intelligent systems that can anticipate disruptions, optimize flows, and support operational continuity. From this perspective, AI constitutes a strategic resource that, when embedded into organizational routines, fosters the development of sustainable competitive advantages (Toorajipour et al., 2021). This view is reinforced by contemporary research framing AI as a foundational capability for strategic agility and innovation (Mikalef & Gupta, 2021).

2.2. Supply chain capabilities

Supply chain capabilities refer to an organization's ability to ensure visibility, integration, and agility across logistics flows. They encompass coordination among partners, responsiveness to disruptions, and flexibility in reconfiguring networks. These capabilities translate the extent to which organizations are able to transform data into concrete operational actions (Pan et al., 2025; Khan et al., 2024). They act as the critical mechanism through which the technological potential of AI is converted into measurable performance improvements. Recent studies specifically highlight how AI enhances resilience and adaptability, which are core supply chain capabilities in volatile environments (Kazancoglu et al., 2023).

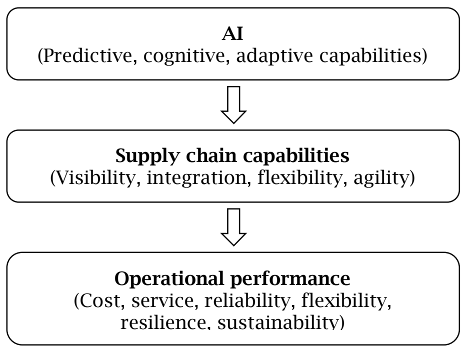
2.3. Operational performance

Operational performance reflects the outcomes achieved in terms of cost, productivity, reliability, quality, and flexibility. Historically measured through financial and logistics indicators, this notion has expanded to include resilience, sustainability, and traceability. It represents the ultimate manifestation of transformations induced by AI, mediated through enhanced supply chain capabilities (Wong & Ngai, 2025; Dubey et al., 2021). The performance outcomes are thus multidimensional, where AI contributes not only to traditional efficiency but also to sustainable performance (Benzidia et al., 2024) and operational agility (Wong et al., 2024).

2.4. Relationships between variables

The conceptual framework suggests that AI acts as a catalyst for supply chains' capabilities. By improving visibility, decision-making quality, and reconfigurability, AI enhances the ability of firms to synchronize flows, reduce inefficiencies, and strengthen inter-organizational coordination. Once developed, these capabilities translate into superior operational performance, observable through cost reductions, service reliability, adaptability, and resilience. At the same time, AI can exert a direct effect on performance, for instance, through predictive optimization and intelligent automation (Pan et al., 2025; Sharma et al., 2022). Empirical work confirms these intertwined relationships, showing that AI-driven analytics positively influence supply chains' agility, which in turn drives performance (Wong et al., 2024), and that the integration of AI with technologies like blockchain directly improves transparency and operational outcomes (Dubey et al., 2021). Taken together, these dynamics indicate that operational performance does not solely depend on technological adoption but on the coherent deployment of AI within enhanced supply chain capabilities.

Figure 1. Conceptual model of artificial intelligence, supply chain capabilities, and operational performance



The model shows AI as both a direct and indirect driver of operational performance. Its main effect is mediated through supply chain capabilities such as visibility, agility, and resilience, which translate technological potential into cost reduction, reliability, and sustainability. Contextual factors like environmental dynamism may moderate these relationships.

3. RESEARCH METHODOLOGY

This study employs a structured bibliometric methodology to analyze the dynamics of scientific publications on AI applied to SCM and operational performance. To ensure methodological rigor — and thus the reliability of the results — we followed a systematic, transparent, and reproducible process. The methodology is articulated in three main phases: 1) corpus construction and selection criteria, 2) tools and analytical techniques, and 3) a complementary qualitative approach to ensure scientific reliability.

3.1. Corpus construction and selection criteria

The research corpus was constructed in accordance with the PRISMA 2020 guidelines (Page et al., 2021), which provide a standardized framework for reporting each stage of the publication selection process. To ensure comprehensive coverage and source triangulation — thereby mitigating the bias inherent in relying on a single database — the literature search was conducted across five major scholarly databases: Scopus, Web of Science (WoS) Core Collection, IEEE Xplore, SpringerLink, and ScienceDirect (Elsevier). This multi-source approach is established practice in rigorous bibliometric research (Aria & Cuccurullo, 2017).

A comprehensive Boolean search string was developed to capture publications at the intersection of the study's three core themes: AI, SCM, and operational performance. The search was adapted to the syntax of each database and applied to titles, abstracts, and keywords. The core query structure was:

("artificial intelligence" OR "machine learning" OR "deep learning" OR "neural network" OR "predictive analytics") AND ("supply chain" OR "logistics" OR "inventory management" OR "demand forecast" OR "operations management") AND ("operational performance" OR "efficiency" OR "resilience" OR "agility" OR "productivity" OR "cost reduction")

The search was limited to peer-reviewed journal articles and reviews published in English between January 2010 and December 2024, capturing the modern era of AI application in SCM characterized by rapid technological advances and increasing supply chain digitization (Ivanov & Dolgui, 2021).

Explicit exclusion criteria: A multi-stage screening process was governed by strict criteria. Records were excluded if they were:

1) duplicates;

2) non-peer-reviewed (e.g., editorials, conference proceedings, book chapters);

3) not published in English;

4) focused purely on AI algorithm development without a clear SCM application context;

5) focused on SCM without an AI/machine learning component;

6) lacking a discernible link to operational performance metrics (e.g., discussing only financial or marketing outcomes).

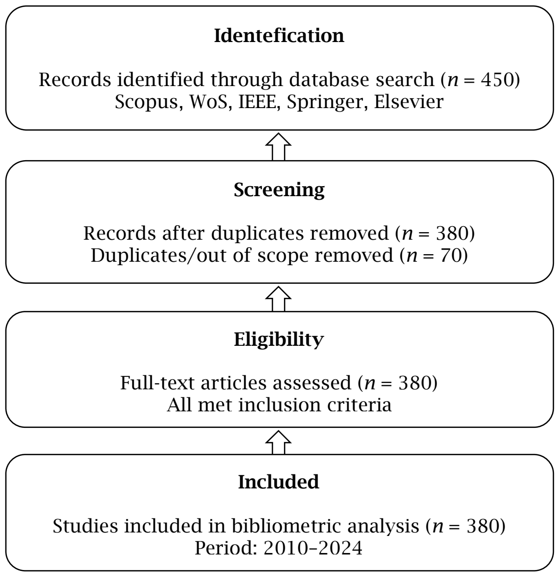
The initial search across all databases yielded 450 records. A rigorous, multi-stage filtering process was then applied, as summarized in Figure 1 (PRISMA Flowchart):

1. *Screening*: 70 records were removed due to duplication or because they were clearly outside the study's scope based on title/abstract review against the exclusion criteria. This resulted in 380 articles proceeding to the eligibility assessment.

2. *Eligibility assessment*: The titles and abstracts of the 380 articles were reviewed against strict inclusion criteria, requiring that each article explicitly address AI applied to SCM with a discernible link to operational performance (Donthu et al., 2021). Following this assessment, all 380 articles were deemed potentially relevant and advanced to the full-text review stage.

3. *Inclusion (full-text review)*: The full texts of the 380 articles were thoroughly examined. This final verification confirmed that all 380 studies met the inclusion criteria. Consequently, the final corpus for bibliometric analysis consists of 380 studies.

Figure 2. PRISMA flowchart of article selection and inclusion for bibliometric analysis (2010–2024)



This figure traces the methodological selection process of articles, from initial identification to final inclusion. It highlights the rigor applied in filtering and evaluating sources, ensuring that the retained corpus (380 studies between 2010 and 2024, including more than 30 key authors) constitutes a solid and scientifically reliable base for bibliometric analysis.

Corpus construction is a preparatory step; it takes full meaning only when combined with the analytical methods that exploit it. It is, therefore, now necessary to present the tools and analytical techniques used to transform the collected bibliographic data into interpretable results, revealing thematic, theoretical, and geographical dynamics of research.

3.2. Tools and analytical techniques

The bibliometric analysis was performed using VOSviewer (version 1.6.20), a reference software tool for constructing and visualizing scientific networks (van Eck & Waltman, 2010). Data extracted from the source databases were exported, cleaned (involving duplicate removal, keyword harmonization — merging synonyms like "AI" and "artificial intelligence" — and author name standardization), and imported into VOSviewer to ensure analytical reliability.

Three complementary network analyses were conducted on the corpus with the following exact parameters:

1. *Keyword co-occurrence analysis*: This analysis was performed to map the conceptual structure of the field. The co-occurrence network was generated using all keywords with full counting. A minimum occurrence threshold for a keyword was set to 10. The resulting network was partitioned into thematic clusters using VOSviewer's built-in clustering algorithm based on association strength. To trace thematic evolution, the overlay visualization mode was applied, color-coding keywords by their average publication year. The resulting network is presented in Figure 4.

2. *Author co-citation analysis*: This analysis was conducted to identify foundational scholars and intellectual groups. The network was constructed from cited references. A minimum citation threshold of 25 was set for an author to be included in the network. The resulting map, showing clusters of co-cited authors, is presented in Figure 5.

3. *Country collaboration analysis*: This analysis was carried out to reveal international research partnerships. The unit of analysis was countries (derived from author affiliations), using full counting. The minimum number of documents for a country was set to five, and the minimum number of collaboration links was set to one. The resulting network of international collaboration is presented in Figure 6.

Together, these three analytical techniques — focusing on themes, intellectual foundations, and geographical cooperation — were employed to provide a multi-dimensional, structural understanding of the research landscape.

3.3. Qualitative approach and scientific reliability

To complement the quantitative bibliometric maps and provide interpretative depth, a qualitative approach was adopted through an in-depth examination of the most cited and influential articles. This methodological triangulation is widely recommended in bibliometric research (Donthu et al., 2021).

A purposive sample of articles was selected for qualitative content analysis, including: a) the 30 most globally cited papers in the corpus, and b) the most central papers from each major thematic cluster identified in the co-occurrence analysis. This analysis focused on extracting the specific AI-SCM application, theoretical foundations, and proposed mechanisms linking technology to operational outcomes. For instance, beyond noting the centrality of the keyword "resilience" in the network, a close reading of seminal papers (Papadopoulos et al., 2017) reveals how AI is concretely modeled to enhance adaptive capacity.

The combination of rigorous data extraction, systematic filtering, detailed bibliometric mapping with explicit parameters, and qualitative reading ensures the robustness and scientific validity of the study, enabling both the identification of macro-structures and a nuanced understanding of the underlying intellectual dynamics.

4. RESULTS

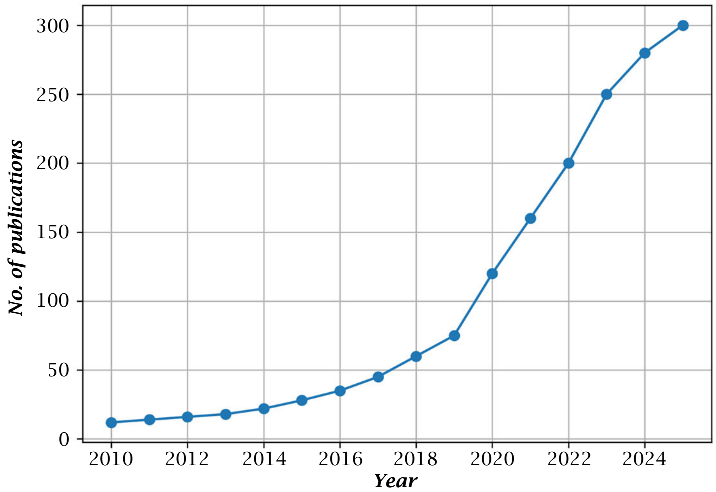
The analysis of the findings drawn from the corpus of 380 selected articles reveals three main thematic clusters of the scientific evolution relating to AI applied to supply chains and its direct and indirect impact on operational performance. The analysis reveals three clear, structuring dimensions. The first concerns the evolution of key themes, reflecting a gradual shift in research interests from technical and algorithmic approaches towards more strategic issues such as resilience, sustainability, and collaborative decision-making. The second dimension is the central role of certain authors and foundational works, whose influence structures citation networks and guides the trajectory of subsequent research. Finally, the third dimension is marked by growing internationalization, illustrated by the multiplication of inter-university collaborations and the expansion of geographical areas involved in these studies, particularly in Asia, Latin America, and Africa, thus indicating an expansion of the field's geographic scope in this research.

The visualizations generated by VOSviewer provide a graphical representation of these complex dynamics, highlighting the relationships between keywords, authors, and countries, and facilitating the identification of expertise hubs as well as emerging trends. This perspective helps visualize the broader dynamics structuring the field, emphasizing both the continuity of scientific debates and the emergence of new research streams.

4.1. Evolution of research themes and structuring of clusters

The main observation that emerges from the analysis concerns the chronological evolution of publications. Between 2010 and 2024, scientific output remained relatively limited, marked by a handful of exploratory contributions focusing on the application of forecasting algorithms to demand and inventory management (Nguyen et al., 2018). This period corresponds to an initial phase of experimentation, during which AI in SCM was still perceived as an emerging field, lacking real conceptual structuring. From 2015 onward, the literature experienced exponential growth, reflecting the consolidation of the field and the growing recognition of AI's role in optimizing logistics processes, a trend confirmed by several recent bibliometric studies. The COVID-19 pandemic marked a turning point: between 2020 and 2021, the number of publications doubled, demonstrating heightened interest in resilience and operational continuity in the face of global crises (Ivanov & Dolgui, 2021; Papadopoulos et al., 2017).

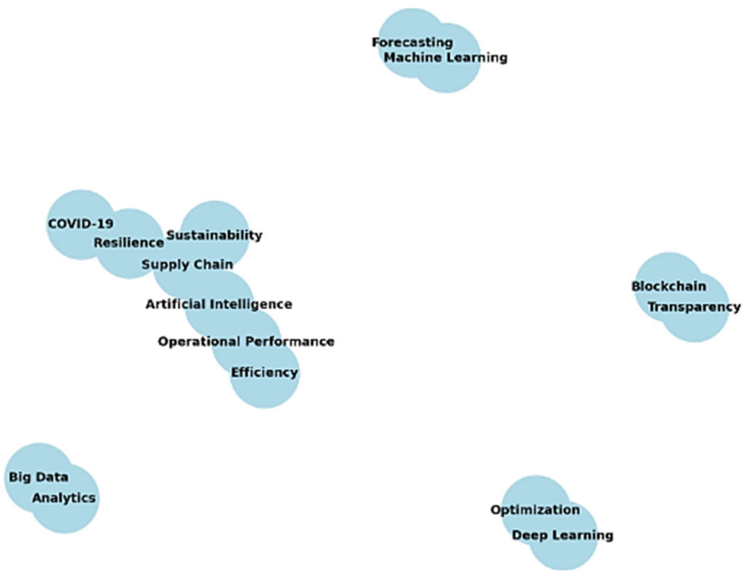
Figure 3. Trends in artificial intelligence-related publications on supply chain and operational performance (2010–2024)



The examination of keyword co-occurrences takes on full meaning to identify three major structuring thematic axes (see Figure 4). The first is centered on predictive optimization and brings together terms such as AI, machine learning, deep learning, forecasting, and optimization. This cluster highlights a technical approach to operational performance, emphasizing forecasting accuracy and productivity improvement through the intensive use of advanced algorithms (Dubey et al., 2021; Wankmüller & Reiner, 2020). The second axis relates to sustainability and transparency issues, with concepts such as blockchain, traceability, and sustainability. This recent orientation reflects the convergence of AI with other digital technologies, particularly blockchain, and reveals heightened sensitivity to environmental and societal issues, especially around traceability and supply chain responsibility (Queiroz & Fosso Wamba, 2019; Naz et al., 2022). Finally, the third cluster, which emerged primarily after 2020, revolves around resilience and operational continuity, directly linked to the global health crisis. Keywords such as COVID-19, resilience, and efficiency illustrate this focus, highlighting the decisive role of AI in strengthening the robustness and adaptability of supply chains in the face of major disruptions (Papadopoulos et al., 2017; Ivanov & Dolgui, 2021).

These results demonstrate that the evolution of research follows a progressive trajectory, moving from an initial interest focused on technical applications to a broader approach that now integrates the strategic, societal, and resilience-related dimensions of SCM.

Figure 4. Keyword co-occurrence network



Source: Authors' elaboration using VOSviewer.

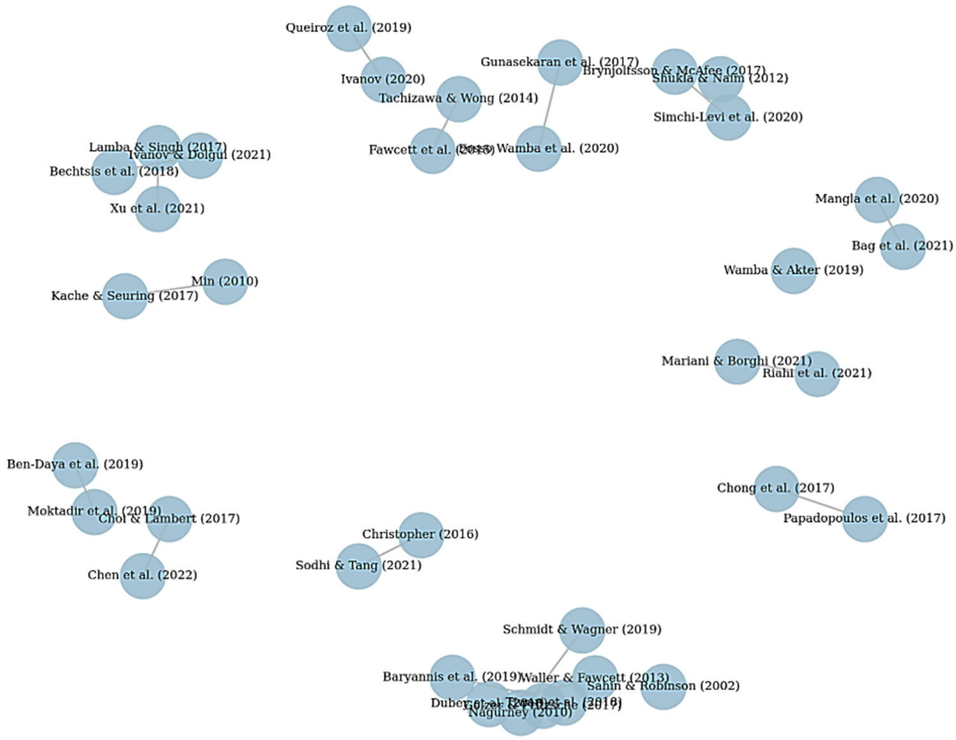
4.2. Influence of authors and scientific structuring

The analysis of the author co-citation network (see Figure 5) highlights the decisive influence of certain scholars who have shaped the research field on AI and SCM in a lasting way. Simchi-Levi et al. (2014) emerge as a central reference, with their work on the modeling and optimization of supply chains constituting a widely mobilized theoretical and methodological foundation in recent literature. In another dynamic, Choi et al. (2023) and Dubey et al. (2021) form a particularly visible pole of influence, with their research focusing on process digitalization, organizational resilience, and the emergence of new conceptions of performance. Their contributions illustrate how AI is reconfiguring not only operational practices but also the indicators used to measure and manage supply chain performance (Choi et al., 2023; Dubey et al., 2021).

A second research stream is led by Fosso Wamba (2017) and Gunasekaran et al. (2017), whose work on big data analytics and Industry 4.0 has significantly enriched the field by linking AI to digital infrastructures and corporate digital transformation. Their influence is reflected in a high density of citations and in the recognition of their research as essential references in the study of relationships between advanced technologies and supply chain competitiveness (Fosso Wamba, 2017; Fosso Wamba et al., 2020). Finally, Sharma et al. (2022) are gradually emerging as a reference author by emphasizing more recent issues related to sustainability, social responsibility, and AI ethics in supply chain applications.

These different poles show that the field is not solely structured around established figures but remains open to new contributions. The coexistence of historical authors and emerging scholars reflects a dynamic of constant renewal, where foundational works continue to provide a solid conceptual basis while new perspectives broaden the field toward contemporary concerns such as resilience, sustainability, and digital transformation.

Figure 5. Author co-citation network



Source: Authors' elaboration using VOSviewer.

4.3. Dynamics of international collaborations and the internationalization of research

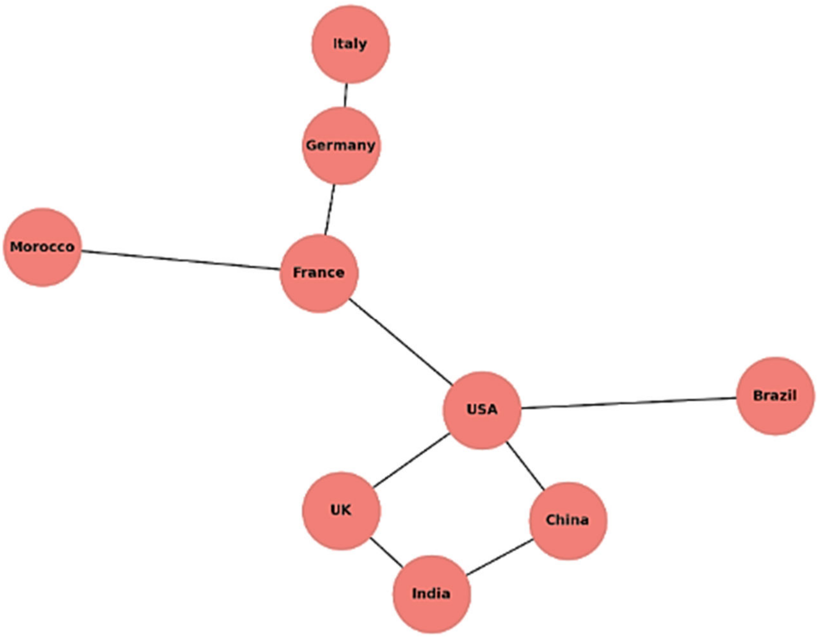
The analysis of the international collaboration network (see Figure 6) underscores the predominant role of the United States, which appears as a genuine scientific hub in the field of AI applied to SCM. Its centrality is explained not only by the high volume of publications but also by the density of its partnerships with other countries, notably China, the United Kingdom, France, and Brazil. China occupies an increasingly prominent position thanks to its steady growth in scientific output and the establishment of strategic collaborations, particularly with India. This dynamic reflects China's rapid scientific ascent on the global stage and its ambition to establish itself as a key player in the domain of digitalization and supply chain optimization (Hajkowicz et al., 2023).

In Europe, bibliometric analysis reveals strong synergies spearheaded by France, Germany, and Italy. These countries tend to concentrate their research efforts on themes related to sustainability, circularity, and the green transition, which reflects a scientific orientation closely aligned with current societal and environmental concerns (Benatiya Andaloussi, 2024; Zejjari & Benhayoun, 2024). This emphasis contributes to diversifying research perspectives by linking operational performance with sustainable responsibility, confirming Europe's importance as a leading academic actor in the global dialogue on intelligent supply chains.

Furthermore, the growing internationalization of the field is evidenced by the emergence of new contributors from regions long marginalized in academic debates. Morocco illustrates this progressive opening of the Maghreb, with contributions focusing on the digitalization of logistics processes and the integration of intelligent technologies in supply chains (Riahi et al., 2021). Although still relatively recent, this participation demonstrates the willingness of countries in the Global South to engage in international scientific networks and to highlight local issues such as industrial competitiveness and the adaptation of supply chains to regional constraints.

Overall, these dynamics confirm that research on AI and SCM is part of a broader process of scientific globalization. It relies both on the consolidation of major traditional poles (the United States, Europe, and China) and on the gradual integration of new academic actors, which enriches the diversity of approaches and fosters the emergence of interdisciplinary and intercultural perspectives.

Figure 6. International collaboration network



Source: Authors' elaboration using VOSviewer.

5. DISCUSSION

5.1. Synthesis of results

A striking phenomenon highlighted by the bibliometric analysis is the concentration of scientific influence around approximately thirty articles that alone account for more than 50% of total citations. Among these major contributions, we find Dubey et al. (2021), Fosso Wamba (2017), Queiroz and Fosso Wamba (2019), Papadopoulos et al. (2017), Ivanov and Dolgui (2021), as well as Wankmüller and Reiner (2020). These structuring works constitute the theoretical and empirical foundations currently organizing the research field, and they confirm three major contributions of AI in the domain of SCM.

5.1.1. Optimization of flows and more accurate forecasting

Artificial intelligence significantly enhances the quality of demand forecasting and optimizes the management of inventories and procurement. Machine learning algorithms, by integrating vast datasets from both internal and external sources, surpass traditional statistical approaches in terms of accuracy and responsiveness. This fosters better planning of physical flows, reduces storage costs, and minimizes stockouts. The contributions of Dubey et al. (2021) and Wankmüller and Reiner (2020) demonstrate that these advances translate directly into improved operational performance, particularly in environments marked by high demand volatility.

5.1.2. Transparency and sustainability through integration with blockchain

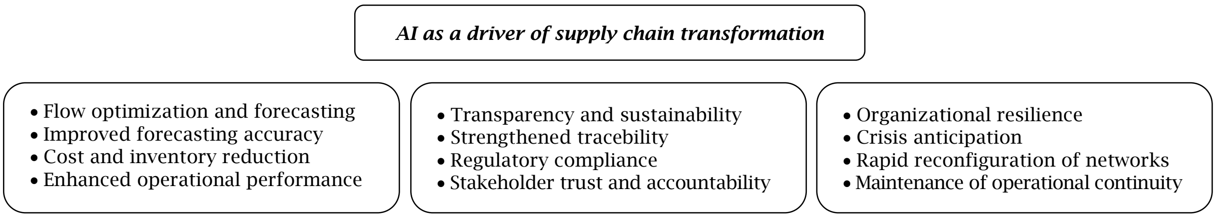
One of the most innovative contributions lies in the articulation of AI with complementary technologies such as blockchain. This technological convergence strengthens product traceability across the supply chains, ensuring greater transparency for consumers and partners. Moreover, it contributes to promoting sustainable practices by guaranteeing the tracking of raw material origins, limiting counterfeiting, and facilitating compliance with environmental and social standards. The works of Queiroz and Fosso Wamba (2019) and Fosso Wamba (2017) highlight this societal and environmental dimension, showing how AI and blockchain operate as levers of a responsible and ethical supply chain.

5.1.3. Strengthened resilience in the face of global crises

Since the COVID-19 pandemic, a key research focus has emerged on the role of AI in enhancing resilience and operational continuity in supply chains. AI provides predictive and prescriptive tools that anticipate disruptions, enable rapid reconfiguration of logistics networks, and maintain a minimum level of service during crises. Ivanov and Dolgui (2021) and Papadopoulos et al. (2017) emphasize that the pandemic acted as a catalyst, accelerating the adoption of intelligent solutions to reinforce the robustness of supply chains. AI is no longer viewed solely as an optimization tool but as a strategic component of risk management and adaptation to systemic shocks.

To better illustrate these three main contributions, Figure 7 provides a schematic synthesis of the role of AI in SCM.

Figure 7. Synthesis of the main contributions of artificial intelligence to supply chain management



In sum, the review of the literature confirms that AI has become an indispensable pillar of supply chain transformation. It acts simultaneously as an instrument of operational precision, a driver of transparency and sustainability, and a catalyst of organizational resilience. Together, these contributions outline the contours of a redefined supply chain — more efficient, more responsible, and better prepared to face contemporary uncertainties.

5.2. Discussion of results

The interpretation of bibliometric results takes on full meaning and moves beyond simple cartography in order to understand what scientific trends reveal about the role of AI in supply chains and its impact on operational performance. The evolution of keywords, dominant authors, and international collaborations illustrates a progressive transformation of the field, one that can be linked to several fundamental theoretical frameworks in management and strategic studies. Three structuring axes emerge: predictive optimization of flows, the integration of AI with complementary technologies such as blockchain to enhance traceability and sustainability, and the role of AI in organizational resilience. Beyond this cartography, the article demonstrates that AI, far from being a mere technical tool, has become a strategic resource that redefines governance models and reshapes the very notion of performance.

The first interpretative perspective draws on the RBV (Barney, 1991), which posits that firms achieve sustainable competitive advantage by developing resources that are rare, valuable, inimitable, and difficult to substitute. The axis related to predictive optimization of flows fully illustrates this logic. Findings indicate that AI is increasingly mobilized not only to improve demand forecasting and reduce logistical inefficiencies but also to generate unprecedented analytical capabilities that strengthen overall competitiveness. Studies by Fosso Wamba (2017) and Dubey et al. (2021) confirm that firms capable of integrating AI systemically develop organizational agility, a key determinant of performance in uncertain environments. In this sense, AI should be viewed as a strategic resource at the very core of the value chain.

A second line of interpretation is provided by agency theory (Jensen & Meckling, 1976), which emphasizes information asymmetries and monitoring costs in contractual relationships. The second axis of the study — the integration of AI with complementary technologies such as blockchain — directly reflects this perspective. Bibliometric analysis highlighted the growing prominence of keywords related to transparency, traceability, and sustainability. The AI–blockchain association helps reduce agency costs by enhancing visibility across flows, automating performance monitoring, and ensuring data integrity. Research by Queiroz and Fosso Wamba (2019) and Naz et al. (2022) demonstrates that this technological convergence not only strengthens regulatory compliance but also reinforces trust among partners, embedding supply chains within a framework of responsible and sustainable governance.

Finally, a third interpretative lens comes from contingency theory (Donaldson, 2001), which stresses that organizational effectiveness depends on the fit between adopted technologies and the context in which they are deployed. The third axis — organizational resilience — perfectly illustrates this approach. Results show that AI contributes to operational continuity during crises, notably by enabling rapid reconfiguration of supply networks and real-time analysis of disruptions. Studies by Papadopoulos et al. (2017) and Ivanov and Dolgui (2021) confirm that the effectiveness of these solutions, however, depends on firms' digital maturity, industry sector, and available resources. Contingency theory thus explains why AI yields variable benefits and why its effectiveness must be tailored to specific organizational contexts.

To better synthesize the theoretical anchoring of our findings, Table 1 provides a comparative overview of the three main theoretical perspectives (RBV, agency, and contingency theories) and their specific contributions to understanding AI's impact on SCM and operational performance.

Table 1. Theoretical synthesis of artificial intelligence in supply chain management

Theory	*Core assumptions*	*Application of AI in SCM*	*Contribution to operational performance*
RBV (Barney, 1991)	Competitive advantage comes from rare, valuable, inimitable resources.	AI as a strategic resource (data-driven, predictive systems)	Efficiency, competitiveness, agility
Agency theory (Jensen & Meckling, 1976)	Reduce information asymmetry, agency costs, and monitoring gaps.	AI + blockchain improve visibility, automate performance tracking	Transparency, compliance, trust
Contingency theory (Donaldson, 2001)	Effectiveness depends on the fit between technology and context.	AI benefits vary by digital maturity, resources, and industry sector	Adaptability, resilience, crisis management

From a managerial standpoint, these three axes offer concrete insights. Predictive optimization of flows demonstrates that AI should be embedded as a central lever of competitiveness rather than as an isolated automation tool. The AI-blockchain integration underlines that supply chains' performance now extends beyond efficiency gains to encompass transparency, accountability, and sustainability. Lastly, the resilience axis underscores that companies must treat AI as a strategic instrument for risk anticipation and crisis management. Together, these dimensions confirm that performance, historically defined in financial and operational terms (Kaplan & Norton, 1996), is today being redefined in a multidimensional logic integrating continuity, sustainability, and governance.

Ultimately, the analysis highlights that AI simultaneously operates within three major theoretical registers: it constitutes a strategic resource as described by the RBV, functions as a governance mechanism echoing agency theory, and acts as a contingent technology whose effectiveness depends on organizational context. The three identified axes — predictive optimization of flows, strengthening of transparency and sustainability through blockchain integration, and contribution to organizational resilience — translate this triple reading. Far from being confined to a purely instrumental role, AI emerges as a structuring vector that reconfigures governance logics and profoundly reshapes the very conception of performance within supply chains.

Beyond theoretical insights, it is crucial to highlight the practical and academic implications of these findings. Table 2 summarizes the theoretical, managerial, and academic contributions emerging from this study, providing a comprehensive view of AI's transformative role in SCM.

Table 2. Theoretical, managerial, and academic implications of artificial intelligence in supply chain management

Dimension	*Key insights from results*	*Implications*
Theoretical implications	AI is both a strategic resource (RBV), a governance mechanism (agency), and a contingent technology (contingency).	Reinforces the need for integrative frameworks combining multiple theories to explain AI's impact on SCM.
Managerial implications: flow optimization	AI improves forecasting, reduces costs, and enhances operational efficiency.	Managers should invest in predictive analytics and AI systems to strengthen competitiveness.
Managerial implications: transparency and sustainability	AI combined with blockchain improves traceability, compliance, and consumer trust.	Firms should integrate AI-blockchain solutions to meet sustainability and regulatory requirements.
Managerial implications: resilience	AI provides predictive tools for crisis management and operational continuity.	Companies must adopt AI for risk anticipation, resilience, and crisis recovery strategies.
Academic implications	Research is fragmented across disciplines; clusters identified are: predictive optimization, transparency/ sustainability, and resilience.	Future studies should integrate interdisciplinary perspectives, focus on underexplored regions (Africa, Latin America), and assess long-term AI impacts.

5.3. Managerial and practical implications

This study emphasizes that AI should be viewed as a strategic lever of competitiveness rather than as a mere automation tool. Its integration enhances demand forecasting, reduces costs, and increases supply chains' agility in environments characterized by uncertainty.

The convergence between AI and blockchain opens up major opportunities in terms of traceability, compliance, and stakeholder trust. Managers are, therefore, encouraged to deploy these technologies not only to meet regulatory requirements but also to differentiate themselves through sustainable and responsible practices.

Finally, AI represents an essential instrument of organizational resilience. It enables firms to anticipate disruptions and maintain operational continuity during crises. However, its adoption must be tailored to the specific organizational context in order to avoid costly investments without tangible performance outcomes.

6. CONCLUSION

The reflection developed throughout this work highlights the profound transformations induced by AI in the field of SCM and their influence on the operational performance of industries. The bibliometric analysis, drawing on scientific databases and tools such as VOSviewer and Bibliometrix, has revealed not only emerging trends but also the structuring of the research field. Findings show a growing academic interest in the articulation between flow optimization, process automation, organizational resilience, and performance monitoring enabled by AI technologies. The literature confirms that AI cannot be reduced to a mere technical lever; it acts as a structuring factor that reconfigures supply chain governance and modifies the logics of interdependence among actors. This dynamic provides industrial firms with a competitive advantage, not only by reducing costs and improving operational efficiency, but also by strengthening transparency, security, and visibility — dimensions that are increasingly strategic in an environment marked by uncertainty and global market volatility.

Identifying the most influential authors, journals, and thematic clusters situates this research within an intellectual ecosystem where management, engineering, and data science converge. Keyword co-occurrence networks have shown that terms such as machine learning, blockchain, performance, optimization, resilience, and digital transformation occupy a central position, reflecting the convergence between quantitative modeling approaches and managerial concerns. This observation corroborates the contributions of Simchi-Levi et al. (2014), who highlight the role of AI in rationalizing decision-making processes, but also aligns with the work of Treiblmaier (2018), who stresses the importance of considering the organizational and human implications of technological innovations. In the same vein, recent studies, such as Chang and Chen (2020) and Charles et al. (2023), confirm that blockchain and intelligent algorithms are paving the way for new forms of transaction security and partner integration, positioning AI as both a governance mechanism and an operational control tool.

Beyond empirical findings, bibliometric analysis has enabled the mapping of relationships among scholars, institutions, and themes, revealing a strong concentration of publications in certain regions (the United States, Europe, and China) and a gradual rise of contributions from emerging economies. This geography of research reflects both the universality of the challenges linked to AI in supply chains and the diversity of application contexts. While industries in developed countries tend to emphasize technological integration and energy efficiency, those in emerging economies — such as Morocco and other African markets — highlight the gradual adoption and managerial appropriation of these technologies. This heterogeneity enriches the field but also underscores the need for comparative approaches that account for institutional and cultural diversity.

As with all academic research, this study has certain limitations that nuance the presented results while opening avenues for future investigation. The first limitation concerns the reliance on bibliographic databases. Although the use of Scopus and WoS ensures rigor, some relevant contributions, particularly those published in regional journals or non-indexed conference proceedings, fall outside the analysis (Zaman et al., 2025). This selection bias may affect representativeness, especially for underrepresented geographical or disciplinary contexts. A second limitation lies in the nature of the visualization and analysis tools employed. While VOSviewer and Bibliometrix are effective in mapping citation and co-occurrence networks, they do not always capture semantic depth or qualitative dimensions. This creates a risk of reducing theoretical and empirical contributions to schematic quantitative relationships that may not fully reflect the complexity of the phenomenon studied.

A third limitation relates to the evolving nature of the research field. AI and SCM are dynamic domains where new concepts, tools, and applications emerge at a rapid pace (Benzidia et al., 2024; Wong et al., 2024). Any bibliometric analysis, therefore, remains a snapshot taken at a given time and cannot fully anticipate future developments. Lastly, methodological constraints inherent in interpreting bibliometric results should be noted. Networks of co-authors or keywords, however robust, do not necessarily reflect actual collaboration dynamics or deep conceptual convergences; they must be interpreted as indicators rather than definitive proof.

These limitations nonetheless open up particularly stimulating research perspectives. One extension would be to broaden the scope of analysis by integrating diverse sources, including regional databases, professional reports, and doctoral theses, to provide a more comprehensive view of the field.

Another avenue would be the use of mixed methods, combining bibliometric analysis with in-depth qualitative examination of texts, thereby enriching the understanding of the concepts and theoretical frameworks mobilized. Future studies could also pursue comparative analyses between developed and emerging countries, shedding light on the differences in adoption, appropriation, and impact of AI in supply chains depending on institutional contexts. This would contribute to the development of contextualized theories better suited to local realities.

Another promising perspective concerns the managerial and human impacts of AI in supply chains. While the literature often emphasizes operational efficiency and cost reduction, it is equally necessary to explore the transformation of professional roles, the emergence of new skills, and organizational resistance (Zaman et al., 2025). Future research could draw on field surveys and case studies to examine how managers and operational teams experience AI adoption, as well as the mechanisms that facilitate or hinder successful integration.

Finally, a crucial direction lies in longitudinal evaluation of AI's impacts on operational performance. Most existing studies rely on cross-sectional data or theoretical models; there is an urgent need for long-term studies capable of measuring how AI shapes resilience, adaptability, and sustainability over time.

In conclusion, this work underscores a dual reality. On the one hand, AI has undeniably established itself as a major strategic lever for managing supply chains and enhancing operational performance. It reduces uncertainty, strengthens coordination among actors, and fosters new governance models based on transparency and traceability. On the other hand, academic research on this subject, while rich and diverse, must continue to evolve in order to keep pace with technological and industrial transformations. This duality gives legitimacy and urgency to future studies, which must continue to combine scientific rigor with managerial relevance to support decision-making in a constantly changing environment. Far from closing the debate, this study positions itself as a milestone, a reference point, and an invitation to extend collective reflection on the conditions and implications of AI integration into supply chains — placing operational performance at the core of concerns while never neglecting the human and organizational dimensions that underpin it.

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