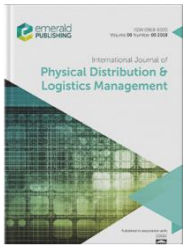
Special Issue



Title: Theorizing the role of Artificial Intelligence in Supply Chain processes: unveiling managerial perspectives and strategic applications
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Guest Editors: Antonella Moretto (Lead Guest Editor), Michela Guida, Maria Elena Latino, Maria Jesús Saénz, Ilya Jackson

Introduction

The infusion of Artificial Intelligence (AI) into Supply Chain Management (SCM) has transitioned from a theoretical exploration to a practical necessity. This evolution from a computational novelty to a strategic imperative underscores AI's role in enhancing decision-making, operational efficiency, and market competitiveness within supply chains. The emergence of large language models (LLMs), such as those developed since early 2023, represents a significant milestone in this journey, illustrating the potential for AI to revolutionize SCM through innovative applications in forecasting, logistics optimization, and real-time tracking and tracing (Hendriksen, 2023; Fosso Wamba et al., 2023).

Despite the acknowledgment of AI's potential, the literature reveals a fragmented understanding of its application across different supply chain functions (Iansiti and Lakhani, 2020). Studies have pinpointed areas where AI can significantly contribute, including demand forecasting, supply chain visibility, dynamic pricing strategies, and optimizing logistics and inventory management (Toorajipour et al., 2021; Helo and Hao, 2022; Merhi and Harfouche, 2023). However, these investigations often treat AI capabilities as a monolith, neglecting the nuanced differences among AI technologies and their respective impacts on specific SCM tasks (Fosso Wamba et al., 2022; Dubey et al., 2020; Grover, Kar, and Dwivedi, 2020).

The theoretical frameworks guiding these studies primarily revolve around innovation diffusion, technology adoption, and strategic management perspectives. Yet, there remains a critical gap in integrating these theories with the unique characteristics and challenges presented by AI in SCM contexts. The predominant use of models such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) has offered foundational insights but falls short in addressing the complexities and developmental nature of AI technologies in supply chain operations.

Moreover, the literature is scant on empirical studies that delve into the real-world implementation of AI by supply chain managers and enterprises. This gap underscores the emergent need for research that not only examines the technological aspects of AI but also its strategic and managerial implications in SCM (Handfield et al., 2019; Guida et al., 2023a; Durach & Gutierrez, 2024). The transition from an IT-centric view of AI advancement to a managerial perspective is crucial for understanding how AI technologies are selected, developed, and integrated into supply chain strategies and operations.

Given this context, the managerial implications of AI adoption in SCM are both significant and underexplored, inhibiting the full potential of AI to flourish as a supportive mechanism within intricate supply networks. Despite the growing interest, the academic landscape is progressively turning its attention toward a comprehensive understanding of the confluence of AI and SCM. There exists a pronounced need for empirical research to elucidate AI's impact on supply chain processes and strategies—research that this special issue aims to advance.

Motivations of the call and expected contributions

In response to these gaps, this special issue seeks to advance the academic discourse by focusing on empirical research that clarifies the role of AI in SCM from a managerial and strategic viewpoint. We aim to uncover how supply chain managers navigate the complexities of AI adoption, the strategies employed to leverage AI for competitive advantage, and the theoretical frameworks that best capture the multifaceted relationship between AI and SCM. Through this lens, the special issue will contribute to a more nuanced and comprehensive understanding of AI's transformative potential in supply chain processes and decision-making paradigms.

Recognizing the multifaceted nature of AI technologies and their impact across various SCM processes, **we invite rigorous empirical research that sheds light on AI's strategic applications from a supply chain managerial perspective**.

The core objectives of this SI are shaped around three aspects:

Empirical Evidence and Managerial Insights: We seek submissions that provide robust empirical evidence of AI's efficacy within SCM, underlining the managerial strategies and decision-making processes involved. Papers should detail the adoption and operational impact of AI on specific supply chain tasks such as forecasting accuracy improvement, enhancement of track and tracing capabilities, optimization of pricing strategies, and efficiency gains in logistical operations. Case studies and data-driven analyses that showcase successful AI integration and the resultant strategic advantages from an SCM perspective are particularly welcome.

Strategic Implementation and Theoretical Advancement: Contributions should delve into the strategic considerations guiding the integration of AI in supply chains, including the identification of challenges and opportunities by supply chain managers. We encourage studies that propose or refine theoretical frameworks to accurately reflect the dynamics of AI in SCM. These frameworks should distinguish between AI and traditional automation, articulate AI's unique capabilities, and explain its role in addressing both longstanding and emerging supply chain challenges.

Navigating Technology Uncertainty: Papers should explore how SCM managers confront and navigate the uncertainty associated with developing and implementing AI technologies. Contributions might examine the collaborative efforts between supply chain managers and AI specialists to tailor AI solutions to specific SCM needs, highlighting the iterative nature of this process and the strategies employed to mitigate technological risks.

In this SI, we seek contributions that transcend traditional theoretical confines, presenting innovative frameworks or significantly revising existing ones to reflect the transformative role of AI more accurately in SCM. Such contributions must distinguish AI from conventional automation, elucidating AI's unique capabilities, its pivotal role in surmounting both longstanding and emergent supply chain challenges, and how it fundamentally differs from traditional automation technologies. The established theoretical models like the TAM, the UTAUT, and the TOE framework, while providing a foundation, often fall short in capturing the nuanced, developmental, and transformative nature of AI in SCM contexts. Consequently, we invite papers that introduce new theoretical perspectives or substantially modify existing frameworks to reflect the strategic impact of AI technologies within supply chains.

Contributions are expected to deliver novel theoretical insights firmly rooted in the operational realities of SCM. Papers should extend beyond theoretical speculation to offer a concrete understanding of the strategic integration and operationalization of AI technologies, with a particular focus on advanced machine learning models and LLMs.

To deepen our understanding of AI's strategic integration into SCM, we advocate for empirical research based on robust methodologies. IJPDLM particularly encourages submissions employing case studies, surveys, action research, design science, and experiments. It is important to note that while quantitative modeling and operations research/optimization models have their place, this SI aims to highlight research methodologies that can offer rich, contextualized insights into the practical application and managerial implications of AI in SCM.

The undeniable transformative potential of AI across various sectors sets a high expectation for its application within SCM. Yet, the actual deployment and tangible real-world applications of AI within SCM have been less conspicuous compared to fields like healthcare, marketing, and analytics. This SI aims to bridge this gap by exploring how companies engage with AI technologies, understanding the requisite data for specific applications, and considering the ways in which AI can enhance distinct supply chain functions. A critical examination of how companies navigate technological uncertainties is imperative, merging insights from innovation and strategy management literature with SCM research.

We call for submissions that document the real-world impact and operational efficacy of AI in SCM, providing empirical evidence of its role in transforming SCM practices. Manuscripts should not only affirm AI's established impact but also contribute to the ongoing discourse on AI's strategic and operational integration within the supply chain sphere.

AI and SCM: application areas, theoretical perspectives, and potential topics

In this context, we outline specific areas where the potential of this technology is gradually being acknowledged and where hands-on, real-world research is greatly needed.

Supply chain synchronized planning

In the planning area, AI emerges as a cornerstone for harmonizing complex inter-organizational activities. The unit of analysis extends beyond individual firms to encompass dyadic pairs and broader network interactions, recognizing the intricate web of collaborative relationships critical to effective supply chain synchronization. AI's role is instrumental in facilitating this coordination, leveraging technologies such as machine learning, natural language processing, and robotics to navigate the increasing complexity inherent in planning processes (Helo and Hao, 2022).

The profound capabilities of AI in enhancing resilience through improved visibility, risk management, and forecasting are pivotal for maintaining business continuity and mitigating the impact of disruptions (Riahi et al., 2021). However, the prevalent use of simulated scenarios and artificial data highlights a gap in our understanding of AI's application to industry-scale challenges–a gap this special issue aims to bridge.

We invite research that:

- Investigates AI's strategic function in designing and refining the supply network, analyzing how AI-enabled analytics influence the decision-making processes across organizational dyads and networks.
- Explores AI's support throughout the product lifecycle, from inception to decline, assessing its role in managing portfolio complexities and synchronization within the supply chain.
- Probes into AI's predictive prowess in forecasting consumer demand, crafting trade promotions, and optimizing pricing strategies, considering the interplay between supply chain actors.
- Examines AI's utility in identifying revenue opportunities and managing supply constraints, with the objective of achieving optimal resource allocation through the lens of multiple supply chain stakeholders.
- Delves into AI's contributions to inventory positioning and supply flow planning, evaluating how AI-driven decisions at one node impact customer satisfaction and profitability across the supply chain.
- Assesses the role of AI in supply chain risk management, focusing on how it aids in forecasting and responding to disruptions, both within and between organizations, to formulate robust business continuity strategies.

Theoretical contributions should offer frameworks to grasp AI's systemic impact on complex, multi-agent supply chain networks, emphasizing reciprocal interactions and integrating fresh perspectives on synchronized planning across multiple entities.

Ordering processes and connected customers

The transformative power of technology in ordering processes marks a pivotal shift in the dynamic interaction with B2B customers, redefining how businesses engage, fulfill, and maintain customer relations. The unit of analysis here centers on the interaction between businesses and their B2B customers, an area ripe for exploration through the lens of AI-enhanced capabilities. Sophisticated data analysis and predictive models derived from AI are reshaping these interactions, enabling an agile response to the ebb and flow of demand patterns. This responsiveness is critical for reducing wait times, optimizing inventory levels, and minimizing operational costs, leading to streamlined supply chain efficiencies (Mohsen, 2023).

In the digital-forward landscape of Industry 4.0, the capacity to process and harness data in real-time is fundamental, affording businesses the agility needed to navigate market changes, customer order variability, and compressed planning cycles (Wang and Pan, 2022; Pournader et al., 2021). While enhancements in customer engagement through technological advancements are well-documented (Menidjel et al., 2022), the granular implications of these technologies, particularly in B2B settings, warrant further investigation. Studies have yet to thoroughly delve into the lifecycle of technology adoption and its downstream effects, elements that are critical to shaping a seamless customer experience and fostering enduring customer loyalty (Chen et al., 2023).

Our call for papers seeks empirical research that illuminates:

- The strategic employment of digital supply networks in strengthening B2B communication, engagement, and retention, with a keen focus on how technology is utilized across multiple communication channels to foster a cohesive customer relationship.

- The amplification of customer service capabilities via technology in a B2B context, enabling service representatives to leverage comprehensive supply chain insights for superior decision-making and issue resolution.

New theoretical perspective frameworks should elucidate AI's role in transforming B2B customer relations, service, and fulfillment in SCM, focusing on data-driven decision-making and customer satisfaction. By capturing the unique intricacies of B2B interactions through the application of AI, these contributions will expand the current understanding and offer actionable insights into the symbiotic nature of technology and customer engagement within SCM.

Intelligent purchasing and supply management

The adoption of AI in procurement is signaling a paradigm shift, augmenting traditional practices with innovative cognitive tools and techniques that reshape the upstream supply chain landscape. Previous research (e.g., Loo and Santhiram, 2018) suggests that AI enhances decision-making capabilities, redefines roles, and facilitates supplier relationships, while fostering cross-functional collaboration. AI's impact is becoming increasingly evident as it streamlines procurement activities, strengthens supply chain partnerships, and provides risk mitigation measures, particularly within the B2B sector (Dwivedi, 2022).

Collaborative developments between IT departments and information providers are leading to advanced solutions that refine supplier discovery processes. AI's deployment in this context aligns intricate information processing needs with the capabilities required for effective supplier scouting (Guida et al., 2023a). Despite these advancements, the literature exhibits significant gaps, particularly concerning the operationalization of AI in procurement (Guida et al., 2023b).

There is a notable lack of research providing practical guidance and managerial perspectives that bridge the gap between potential and actual application. Furthermore, there is an absence of comprehensive models or frameworks that marry human expertise with AI to optimize procurement operations (Spreitzenbarth et al., 2022). To bridge these gaps, there is a call for deep-diving studies that offer actionable insights and implementation guidance, which are crucial for translating research findings into practical procurement applications.

Submissions to this call for papers should focus on empirical studies exploring areas such as:

- AI's efficacy in forecasting purchasing costs, accurately discerning requirements, and evaluating supplier and regional factors, contributing to proactive end-to-end cost management strategies.
- The role of AI in defining category strategies, aiding in supplier selection, and leading value-driven procurement initiatives.
- The transformation of sourcing processes through AI, which includes enhancing the efficiency of supplier self-registration, competitive bidding, and automated negotiations.
- AI's contribution to the digitization of contract management, aiming to achieve cost reductions and meet performance benchmarks.
- The capacity of AI to structure effective collaborations, promoting mutually beneficial relationships between buyers and suppliers that drive procurement success.

New theoretical perspectives are needed to explicate AI's role in procurement, particularly in understanding how AI can supplement and augment human expertise in purchasing strategies. Such frameworks should consider the implications of AI on supplier relationships, risk management, and cost optimization.

Transformation processes and smart operations

AI stands as a transformative force in modern manufacturing, pivotal in realizing smart operations that significantly enhance productivity, quality, and profitability. The integration of AI with advanced manufacturing technologies underpins the concept of 'smart operations', serving as a linchpin for innovation and efficiency in the production landscape (Kovalenko et al., 2023). The role of AI in fostering industrial green total factor productivity is particularly noteworthy, with empirical studies showing that AI adoption correlates with significant productivity gains, stemming from value enhancement, skill bias, and technological advancement (Yang and Shen, 2023; Gao and Feng, 2023).

Despite the clear benefits, the path to operationalizing AI within manufacturing systems is fraught with challenges. The perceived benefits of intelligent systems are not always immediately evident to all organizations (Arinez et al., 2020), and the full extent of AI's potential impact on operations is still unfolding.

Factors influencing the successful implementation of AI in production systems include the quality and accessibility of data, the adequacy of infrastructural support, a thorough cost-benefit analysis, organizational readiness for transformative change, and the nuances of human-AI interaction (Merhi and Harfouche, 2023; Revilla et al., 2023). Each of these areas presents a rich avenue for research and warrants in-depth exploration. Within this context, this special issue calls for empirical research that addresses:

- The application of AI in enhancing the efficiency and effectiveness of production processes, from the optimization of individual operations to the improvement of overall manufacturing performance.
- The strategic utilization of AI for the judicious allocation and utilization of scarce resources, aiming to optimize both the production outputs and the operational workflows.
- How AI supports the enhancement of coordination and visibility across all components of the manufacturing network, from machines and personnel to overarching processes.
- The role of AI in establishing a connected operational ecosystem that provides real-time insights into operational performance, facilitating rapid decision-making and continuous improvement.

In the domain of manufacturing and production, the unit of analysis is the smart factory floor and the interrelated systems that constitute the operational environment. Theoretical contributions to this special issue should, therefore, extend current understanding by providing new models that encapsulate the complex interplay between AI technologies and manufacturing systems. New frameworks should account for how AI-driven data analytics and intelligent automation converge to elevate smart operations, taking into account the multi-dimensional impact on people, processes, and technology in a production setting.

Efficient transportation and dynamic fulfillment

The transportation sector is at the cusp of a technological revolution, where AI is playing a central role in reshaping transportation systems. Utilizing advanced AI techniques, such as artificial neural networks, genetic algorithms, and fuzzy logic models, the industry is addressing complex challenges in traffic management, safety, and urban mobility (Chung, 2021). AI's role in logistics extends to addressing pressing issues such as meeting increased travel demands, reducing carbon emissions, and ensuring safety (Abduljabbar et al., 2019). In freight transport, AI-driven automation is making headway toward more accurate transportation planning and tailored services, promising a new era of cost-efficiency and enhanced service quality (Klumpp, 2018).

Despite these advancements, there remain unexplored territories, especially regarding the implementation of computation-intensive AI applications in logistics vehicles with constrained computing resources (Alkinani et al., 2022; Jackson et al., 2024). Furthermore, the field lacks comprehensive research on the efficient processing and analysis of vast amounts of transportation data, particularly at the network edge where real-time decisions are crucial (Gao et al., 2023). Research methodologies adept at handling large-scale sensory data to deliver highly accurate, real-time results with minimal errors are highly sought after.

Focusing on dynamic fulfillment within the supply chain, this special issue invites empirical research that examines:

- AI's role in orchestrating the complex processes of order confirmation, aggregation, and fulfillment across a network of warehouses, stores, and suppliers, integrating systems like distributed order management, advanced warehouse management, and transportation management systems.
- The design and impact of AI in developing an adaptable network of fulfillment points that can swiftly adjust capacity to accommodate changing demand levels.
- AI's capabilities in determining the most efficient shipping modes and routes, considering factors such as logistics requirements, hub locations, cost efficiencies, and shipping schedules.
- The optimization of the synergy between the human workforce, technological tools, and physical assets through AI, aiming to improve order precision, inventory management, and the pace of the fulfillment cycle.
- The role of AI in automating the entire transportation journey, from the initial departure to the final mile delivery, emphasizing enhancements in efficiency, cost optimization, and reduction in delivery lead times.

We expect theoretical contributions to reflect on the transformative effects of AI in the transportation sector, particularly in the context of dynamic fulfillment. New theoretical frameworks should account for how AI is interwoven with logistic strategies to improve the efficiency and responsiveness of supply chain networks. These frameworks should extend beyond traditional logistics models to include AI's potential to facilitate real-time decision-making, predictive analytics for demand and route optimization, and integration of autonomous systems in the end-to-end delivery process.

Supply chain orchestration and sustainability

AI is rapidly becoming a cornerstone in achieving supply chain orchestration and sustainability. Through advanced information processing, AI not only bolsters supply chain resilience but also amplifies the network's overall performance by enhancing the integration of resources and fostering environmental stewardship (Belhadi et al., 2021). In a world marked by volatility and environmental uncertainties, the integration of AI into supply chain networks is being propelled by its ability to augment collaborative efforts and contribute to the actualization of sustainable development goals (Lim et al., 2021; Sanders et al., 2019).

Despite AI's recognized potential, the academic exploration into its impact on the orchestration of supply chain resources remains embryonic in several critical respects. There is a scarcity of empirical investigations that dissect the dynamic interplay between human behavior and technology, especially regarding how this interaction influences AI adoption and its consequential effects on sustainability and resilience within supply chains (Pan and Nishant, 2023). Existing SCM theories are also found wanting in their capacity to articulate the disruptive influence of AI, signaling a pressing need for innovative theoretical constructs that can untangle the complexity of AI integration within the supply chain network and predict its capacity to transform established SCM practices (Hendriksen, 2023).

Moreover, there is a tendency in current research to examine AI applications in silos, such as natural language processing or machine learning, without fully addressing how these technologies synergize within the broader supply chain context (Hao and Demir, 2023). The imperative now is for meticulous research that dissects the multifaceted dimensions of AI adoption, evaluating how it orchestrates the supply chain and supports sustainability initiatives (Mohsen, 2023).

This special issue invites contributions that investigate:

- The fundamental ways AI supports sustainability and the principles of the circular economy within the interconnected fabric of supply chain networks.
- The catalytic role of AI in eco-design and in fostering cohesive collaboration among diverse stakeholders across the entire product and service lifecycle.
- The capability of AI to architect supply chain platforms that elevate resource efficiency and amplify the value generated across the network.
- AI's influence on the enactment of corporate sustainability strategies within supply chain operations, striving to optimize the consumption of energy and resources and minimize emissions at both micro and macro network levels.

We encourage papers to propose new theoretical perspectives that provide a lens through which the influence of AI on supply chain sustainability can be viewed. These perspectives should incorporate the systemic nature of supply chains and account for AI's potential to drive sustainability through smarter resource orchestration, more informed decision-making, and a deepened commitment to environmental and economic goals across the entire supply chain.

Submission

The authors interested in submitting to the special issue are strongly encouraged to send their proposal and/or research idea to the Guest Editors to receive feedback before full paper submission. Proposals should be around 1,000 words (excluding references, tables, and figures).
All the proposals should be sent to the Managing Guest Editor, **Prof. Antonella Moretto**, at antonella.moretto@polimi.it by **July 15, 2024**.

Manuscripts should comply with the scope, standards, format, and editorial policy of IJPDLM.
All papers must be submitted through the official IJPDLM submission system with a clear selection indicating that the submission is for this Special Issue. Before submission, authors should carefully read over the Journal's "Author guidelines". Particularly, we advise authors to adhere to the journal's word limits for initial submissions (10,000 words, which includes all text, the structured abstract, references, all text in tables, and figures and appendices). Additional research materials for the review process can be included as "Supplementary materials." Supplementary materials are not included in the paper word count and, if the paper will be published, will be uploaded as a separate Word document along with the paper.

Authors should select "SI: AI in SCM", from the "Choose Article Type" pull-down menu during the submission process. All contributions must not have been previously published or be under consideration for publication elsewhere.
Papers submitted to the Special Issue will be subjected to the normal, thorough, double-blind review process.

Key Dates

Submission open: 31st May, 2024
Submission close: 31st December, 2024
Expected final decision outcome by: 1st December, 2025

Guest Editors

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