LITERATURE REVIEW ON THE APPLICATION OF ARTIFICIAL INTELLIGENCE IN SUPPLY CHAIN

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Abstract

This academic paper presents a comprehensive examination of various dimensions within the realm of supply chain management, synthesizing insights drawn from multiple studies. The analysis of dynamic capabilities during the COVID-19 pandemic underscores the non-linear dynamics influenced by environmental dynamism, emphasizing the pivotal role of Alliance Management Capability (AMC) as a precursor to effective AI-Powered Supply Chain Analytics (AI-SCAC). The paper also highlights the practical significance of swift trust in emergencies, offering valuable guidance for both managerial decisions and policy considerations. In exploring blockchain's transformative potential in supply chain finance, the study reveals its capacity to enhance transparency, security, and efficiency. While acknowledging challenges such as credit issues and interoperability gaps, the paper suggests avenues for future research to delve deeper into potential drawbacks and criticisms associated with widespread adoption, opening opportunities for scholars to investigate nuanced implications of integrating blockchain into financial operations within supply chains. The investigation into the digital transformation of manufacturing supply chains in China provides a comprehensive analysis of uncertainties and complexities, offering a strategic roadmap for successful digitalization. Incorporating advanced methodologies like Principal Component Analysis (PCA) and a Backpropagation Neural Network (BPNN) for risk prediction demonstrates methodological rigor and practical applicability. Identifying weak strategy consistency as a significant factor affecting digital supply chain stability adds depth to the discourse, prompting further refinement and improvement in future research endeavors. In essence, this multifaceted exploration contributes valuable insights to the scholarly dialogue surrounding supply chain management, offering practical implications for managerial decisions, guiding policy considerations, and suggesting avenues for future research refinement and expansion. The diverse perspectives presented underscore the intricate interplay of technologies, strategies, and capabilities, emphasizing the need for a holistic understanding to navigate the complexities of modern supply chain ecosystems successfully.

Keywords: Artificial Intelligence (AI), AI-Powered Supply Chain Analytics, Machine Learning in Supply Chain, Predictive Analytics, Robotic Process Automation (RPA)

1. Introduction

Integrating Artificial Intelligence (AI) into supply chain management represents a pivotal paradigm shift, heralding a new era of innovation and efficiency. In response to the intricate challenges of globalized markets and dynamic consumer demands, businesses increasingly turn to AI technologies to optimize their supply chain processes. This survey journal endeavors to systematically explore the multifaceted applications of AI in supply chain management, providing a comprehensive analysis of its impact, challenges, and opportunities. As organizations strive to adapt and thrive in an era of digital transformation, understanding the strategic deployment of AI becomes imperative for orchestrating agile and responsive supply chains.

The significance of this survey is underscored by the urgency for supply chain practitioners and decision-makers to harness the potential of AI in navigating the complexities of modern supply chain ecosystems. The interplay of AI technologies, including machine learning, predictive analytics, and robotic process automation, offers unprecedented capabilities to enhance forecasting accuracy, optimize inventory management, and streamline logistics operations. As we delve into the applications of AI in supply chain management, we aim to unravel not only the benefits but also the challenges and considerations that organizations must navigate to unlock the full potential of these technological advancements.

This survey sets out with a clear mission: to evaluate the current landscape of AI applications in supply chain management comprehensively. Our

objectives include examining successful use cases, identifying emerging trends, and elucidating the potential barriers to adoption. Employing a systematic review methodology, we synthesize insights from a diverse range of scholarly articles, industry reports, and case studies. By delving into the literature, we aim to provide a synthesized perspective that informs strategic decision-making, guides further research initiatives, and contributes to the ongoing dialogue surrounding the transformative impact of Artificial Intelligence in supply chain management.

2. Literature with Benefits and Limitations

One study introduces a novel framework integrating Pareto and B-BWM methodologies to evaluate the role of AI-driven strategies in enhancing supply chain (SC) resilience within the RMG and footwear industries, specifically addressing challenges posed by the COVID-19 pandemic in Bangladesh. (Ahmed et al., 2023) "Real-time tracking of SC activities using IoT" emerges as a critical imperative, addressing visibility gaps, while the equal importance of the "Use of cyber-physical production system" underscores its role in ensuring operational stability and environmental performance. The study also emphasizes the significance of the "Creation of digital SC twin" for real-time data collection and risk reduction. These insights contribute valuable perspectives on SC resilience, particularly for export-oriented industries during the pandemic, with broader implications for similar sectors in emerging economies. Additionally, the research identifies imperatives such as "Production flexibility through automation integration," "Boosting employee safety and operational continuity through AI," and "Application of big data and predictive analytics," highlighting their relevance in navigating challenges posed by the pandemic and emphasizing the potential long-term benefits of adopting Industry 5.0 technologies in emerging economies. (Ahmed et al., 2023)

One of the reviews concludes by discussing the limitations of the study and its managerial and theoretical implications. (Toorajipour et al., 2021) It contributes to theory by analyzing and discussing the state-of-the-art of AI in SCM, covering the most prevalent AI techniques applied in SCM studies, and discussing potential AI techniques that can be employed in future SCM research. The review also addresses the subfields and tasks in SCM that have already been improved using AI and provides insight for future studies in the field. (Toorajipour et al., 2021)

Another review has the analysis revealed a tendency towards short- to medium-term forecasts, with only a single publication forecasting long-term demands.(Mediavilla et al., 2022) The most commonly used metrics for evaluating AI methods were relative mean square error (RMSE), mean absolute percent error (MAPE), mean absolute error (MAE), and mean square error (MSE). Python was the most commonly used software for implementation, followed by R and MATLAB.

A study on the healthcare supply chain emphasizes the importance of technology-driven strategies in improving supply chain efficiencies and addressing challenges in healthcare crises. (Arji et al., 2023) It also highlights the need for further research on the practical application of emerging tools for managing disturbance and ensuring resilience in the supply chain. The study suggests that future research may focus more on the uncertainty modeling approach in healthcare supply chain operations during the COVID-19 pandemic.

A study on AI-powered Supply chain anchored in the Dynamic Capabilities View (DCV), investigates the hierarchy of dynamic capabilities during the COVID-19 pandemic, finding that higher-order capabilities significantly impact performance. It reveals a non-linear relationship influenced by environmental dynamism (ED). (Dubey et al., 2021) Empirical evidence establishes Alliance Management Capability (AMC) as a crucial antecedent to AI-Powered Supply Chain Analytics (AI-SCAC), emphasizing nuanced DCV boundaries. Managerially, senior managers are advised on strategic investments in both higher and lower-order capabilities, with the absence of AMC posing challenges during crises. The study highlights swift trust as crucial, particularly in emergencies. Policymakers are informed about leveraging dynamic capabilities for superior outcomes during pandemics, considering the contingent role of external conditions. The significance of AMC is underscored, detailing its key components.

One paper on the assessment of supply chain logistic performance focuses on optimizing logistic performance in the chemical industry's maritime logistics, introducing key performance measures such as actual logistic cost, unutilized resource costs (ship capacity), and expected costs of production losses. (Bruzzone & Orsoni, 2003) Emphasizing the significance of accurately estimating production loss costs, the paper presents two methodologies—simulation and modular artificial neural networks (ANNs)—to assess and compare logistic management solutions. Testing reveals that the ANN-based approach, particularly with its modular structure, efficiently estimates costs in complex logistic scenarios, providing quick and accurate estimates for entire logistic networks within seconds. This proves advantageous, especially when dealing with logistic networks with limited variability, enabling the reuse of data sets and network modules

across the entire network for substantial time and data collection savings.

This study addresses challenges in integrating IoT and AI technologies into supply chain management, highlighting practical difficulties due to diverse IT systems and technical limitations. (Dubey et al., 2021) It emphasizes the significance of data-centricity in mitigating information gaps in complex supply chains through real-time monitoring and analysis. The paper explores the impact of globalization on supply chain management, acknowledging increased competition and improved supply conditions but underscoring the introduced complexities and risks. Additionally, the study underscores the importance of agility in supply chain management, citing process and information integration, along with the adoption of new technologies, as crucial for optimizing and adapting to factory needs.

This study, anchored in the Dynamic Capabilities View (DCV), investigates the hierarchy of dynamic capabilities during the COVID-19 pandemic, finding that higher-order capabilities significantly impact performance. (Kousiouris et al., 2019) It reveals a non-linear relationship influenced by environmental dynamism (ED). Empirical evidence establishes Alliance Management Capability (AMC) as a crucial antecedent to AI-Powered Supply Chain Analytics (AI-SCAC), emphasizing nuanced DCV boundaries. Managerially, senior managers are advised on strategic investments in both higher and lower-order capabilities, with the absence of AMC posing challenges during crises. The study highlights swift trust as crucial, particularly in emergencies. Policymakers are informed about leveraging dynamic capabilities for superior outcomes during pandemics, considering the contingent role of external conditions. The significance of AMC is underscored, detailing its key components.

The paper examines the findings and trends related to leveraging blockchain technology to alleviate information asymmetry in supply chain finance. (Zhang & Ding, 2021) Through decentralizing the supply chain and utilizing blockchain's features like timestamping, the study proposes enhancing transparency, security, and efficiency. A key highlight is blockchain's role in facilitating credit transmission from core enterprises to edge enterprises, thereby expanding the application of supply chain finance. Identified challenges encompass the credit issues of core enterprises, interoperability gaps, and limitations in traditional financing tools. While the paper suggests that blockchain can address these challenges, it does not explicitly discuss potential obstacles in implementation. Moreover, the text lacks an in-depth exploration of potential drawbacks or criticisms associated with adopting blockchain in supply chain finance.

This paper addresses the digital transformation of manufacturing supply chains (MSC) in China, emphasizing the uncertainty and complexity associated with the dynamic changes in nodes and structure amidst increasing customer demand and market competition. (Liu, 2022) To facilitate a successful switch to a digital MSC, the paper identifies risk sources and constructs an evaluation index system for MSC digitization. Principal Component Analysis (PCA) is employed to reveal three key components for risk prediction, simplifying the structure of a Backpropagation Neural Network (BPNN). The proposed BPNN model demonstrates effective risk prediction in comparison to traditional Artificial Neural Network (ANN) models. The research provides valuable insights into the smooth digital transformation of MSC, particularly in the context of China's manufacturing industry, where uncertainties and risks pose challenges to traditional companies undergoing rapid digitalization. The study identifies weak strategy consistency as a significant factor affecting digital supply chain stability and overall risk management capabilities, offering directions for further research refinement and improvement of the predictive model.

This paper focuses on enhancing risk management in supply chain operations, particularly emphasizing the importance of timely risk identification for proactive management. Recognizing the manual process's inefficiency, the study introduces Reinforcement Learning-based Proactive Risk Identification (RL-PRI) as an artificial intelligence solution. (Aboutorab et al., 2022) The proposed RL-PRI demonstrates effective performance in identifying disruption risk events, showcasing its applicability beyond supply chains to areas like the stock market. Despite its significant results, the paper outlines areas for future improvement, including exploring broader risk taxonomies, expanding news sources, incorporating social media, refining semantic analysis, utilizing NLP APIs for precise entity extraction, and implementing advanced RL algorithms for more complex environments.

3. Result Analysis

In this multifaceted exploration of dynamic capabilities within supply chain management, (Kousiouris et al., 2019) illuminate the intricate relationship between higher-order capabilities and performance, particularly amidst the challenging landscape of the COVID-19 pandemic. The study underscores the non-linear dynamics influenced by environmental dynamism, emphasizing the indispensable role of Alliance Management Capability (AMC) as a pivotal precursor to effective AI-Powered Supply Chain Analytics (AI-SCAC). The insights not only provide managerial guidance for strategic investments in dynamic capabilities but

also extend valuable counsel to policymakers, urging a nuanced understanding of external conditions to harness these capabilities optimally. The study's emphasis on swift trust in emergencies adds a layer of practical significance, contributing to the broader discourse on resilience in supply chain operations during crises.

(Zhang & Ding, 2021) examination of blockchain's role in supply chain finance sheds light on its transformative potential while unveiling critical challenges. The findings emphasize the technology's capacity to enhance transparency, security, and efficiency in financial transactions within the supply chain, particularly through credit transmission mechanisms. However, the study acknowledges obstacles such as credit issues, interoperability gaps, and limitations in traditional financing tools. Notably, the paper offers a valuable foundation for future research but falls short in providing an exhaustive exploration of potential drawbacks and criticisms associated with the widespread adoption of blockchain technology in supply chain finance. This leaves room for further scholarly inquiry into the practical implications and limitations of integrating blockchain into financial operations, providing a springboard for a nuanced understanding of the technology's impact on the finance-scape of supply chains.

(Liu, 2022) investigation into the digital transformation of manufacturing supply chains (MSC) in China offers a comprehensive analysis of the uncertainties and complexities inherent in this evolving landscape. By identifying risk sources and constructing an evaluation index system, the study provides a strategic roadmap for a successful shift to a digital MSC, especially pertinent in the context of China's rapidly digitizing manufacturing industry. The incorporation of Principal Component Analysis (PCA) and a Backpropagation Neural Network (BPNN) in risk prediction demonstrates methodological rigor and practical applicability. The study's recognition of weak strategy consistency as a significant factor affecting digital supply chain stability adds a nuanced layer to the discourse. While offering valuable insights, the research wisely points towards areas for further refinement and improvement, signaling the potential for continued scholarly exploration into the dynamics of digital transformation within manufacturing supply chains.

4. Conclusion

In conclusion, this academic paper undertakes a thorough examination of diverse aspects within the realm of supply chain management, drawing insights from various studies. The investigation into dynamic capabilities during the COVID-19 pandemic emphasizes the non-linear dynamics influenced by environmental dynamism, highlighting the pivotal role of Alliance Management Capability (AMC) as a precursor to effective AI-Powered Supply Chain Analytics (AI-SCAC). The emphasis on swift trust in emergencies contributes practical significance, offering valuable guidance for both managerial decisions and policy considerations.

The exploration of blockchain's transformative potential in supply chain finance reveals its capacity to enhance transparency, security, and efficiency. However, the study acknowledges challenges such as credit issues and interoperability gaps, leaving an avenue for future research to delve deeper into potential drawbacks and criticisms associated with widespread adoption. This presents an opportunity for scholars to investigate the nuanced implications of integrating blockchain into financial operations within supply chains.

The investigation into the digital transformation of manufacturing supply chains in China provides a comprehensive analysis of uncertainties and complexities, offering a strategic roadmap for successful digitalization. The incorporation of advanced methodologies like Principal Component Analysis (PCA) and a Backpropagation Neural Network (BPNN) for risk prediction demonstrates methodological rigor and practical applicability. The identification of weak strategy consistency as a significant factor affecting digital supply chain stability adds depth to the discourse, prompting further refinement and improvement in future research endeavors.

In essence, this multifaceted exploration contributes valuable insights to the scholarly dialogue surrounding supply chain management, offering practical implications for managerial decisions, guiding policy considerations, and suggesting avenues for future research refinement and expansion. The diverse perspectives presented underscore the intricate interplay of technologies, strategies, and capabilities, emphasizing the need for a holistic understanding to navigate the complexities of modern supply chain ecosystems successfully.

5. Future Research Direction

In the realm of risk management for supply chain operations, a burgeoning area of exploration centers around the application of advanced technologies, particularly Reinforcement Learning (RL). This study critically examines existing methodologies and introduces an innovative RL-based framework known as RL-PRI. Building on foundational works within the academic landscape, the research investigates the proactive identification of disruption risk events. Comparative experiments

with traditional manual risk identification methods reveal the promising efficacy of RL-PRI, suggesting its potential applicability across diverse domains, including financial markets. To augment the framework's performance, future research directions are proposed, drawing inspiration from broader taxonomies of risk events, enriched data sources from local news outlets and social media, advanced Natural Language Processing (NLP) techniques, and the incorporation of sophisticated RL algorithms. These proposed enhancements align with the ongoing discourse in academic literature, seeking to contribute to the evolution of proactive risk identification beyond conventional supply chain contexts.

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