Introduction to AI in Supply Chain Management

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ABSTRACT

The application of AI in supply chain management brings significant changes to various critical functions, from demand forecasting to security and risk mitigation. In this article, each aspect will be discussed based on empirical evidence and the latest technology. AI technology enables companies to analyze large amounts of data in real time, detect demand patterns, optimize inventory, and make automated decisions that previously required lengthy manual processes. Additionally, AI can manage the complexity of highly dynamic global supply chains by enhancing visibility, resilience, and operational efficiency. Through the integration of machine learning, deep learning, and reinforcement learning, AI can adaptively adjust procurement strategies, logistics scheduling, and supplier evaluations. Even in terms of security and risk prevention, AI can proactively predict disruptions, analyze supply chain vulnerabilities, and detect anomalies and potential fraud. Therefore, AI is not just a tool but a strategic key to achieving a resilient, adaptive, and competitive supply chain.

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1. INTRODUCTION

Digital transformation presents an efficient way for an organization to manage its supply chain fundamentally. In an era of increasingly complex globalization, reliance on real-time data and smart technology is inevitable. Modern supply chains now face major challenges, ranging from tentative markets, sudden increases in demand, global logistics disruptions, to pressures to expand geographically. At this time, Artificial Intelligence (AI) has emerged as a revolutionary technology that is very useful with several new capabilities, namely understanding, managing, and optimizing supply chain operations dynamically and intelligently.

AI has the ability to process and analyze big data from multiple perspectives in the supply chain to generate predictive insights that were previously unattainable with traditional methods. By leveraging machine learning and deep learning algorithms, AI can describe customer demand, identify supply chain risks in real-time, and make automated decisions for stock and distribution optimization. In addition, AI allows the system to adapt to external changes, such as raw material price volatility or extreme weather conditions, thereby increasing the organization's operational resilience and flexibility in the long term.

AI introduces tremendous potential to mitigate key challenges in Supply Chain Management (SCM), including demand prediction, inventory management, supplier selection, logistics scheduling, risk analysis, and real-time decision making. The application of technologies such as Machine Learning (ML), Deep Learning (DL), Reinforcement Learning (RL), XAI, and Neurosymbolic.AI are widely used by global organizations in various sectors, ranging from retail, manufacturing, logistics, to healthcare (Douaioui et al., 2024; Teixeira et al., 2025).

Artificial intelligence (AI) has become an essential driver in the digital transformation of supply chain management, particularly in the context of globalization. The increasing complexity of international supply networks requires advanced technological solutions that can enhance planning, improve decision-making, and promote sustainability. In this regard, AI plays a central role by not only increasing operational efficiency but also enabling organizations to adapt more quickly and effectively to the dynamic changes of global markets (Akash Abaji Kadam et al., 2025).

The importance of this study also lies in its ability to present a comprehensive view of AI adoption in supply chains from multiple perspectives. It bridges the gap between academic research and industrial practices, offering insights that are relevant across different regions and sectors. Furthermore, the discussion highlights the challenges faced in adopting AI, particularly in small and medium-sized enterprises, developing countries, and industries that are subject to strict regulations (Hangl et al., 2022).

Given this wide-ranging scope, AI in supply chain management is expected to serve as a global reference point for academics, practitioners, and policymakers. It provides a foundation for developing strategies that ensure the ethical, inclusive, and sustainable implementation of AI in global supply chain ecosystems (Bigliardi et al., 2025)

The development of AI in SCM has undergone significant evolution from traditional expert systems to advanced technologies such as machine learning and deep learning. Samuels (2024) emphasizes the importance of understanding the transition from Industry 4.0 to Industry 6.0, showing how the integration of AI in supply chain management has systematically evolved through various phases of industrialization (Samuels, 2024). This historical context is crucial for understanding the initial challenges such as computational limitations, data complexity, and organizational resistance that ultimately drove the innovation of modern AI solutions. Without understanding this evolution, readers lose a critical perspective