

AI IN SUPPLY CHAIN MANAGEMENT: ENHANCING EFFICIENCY

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Abstract:

The increasing complexity of global supply chains has created a strong need for smarter and more adaptive management approaches. Artificial intelligence (AI) has emerged as a transformative technology capable of enhancing efficiency, accuracy, and decision-making across supply chain operations. This study examines the role of AI in supply chain management, with a focus on its contribution to demand forecasting, inventory optimization, logistics coordination, and overall operational performance. Based on an extensive review of freely accessible academic literature, the findings indicate that AI applications significantly improve supply chain responsiveness and reduce operational uncertainties. However, challenges such as data quality issues, high implementation costs, and skill gaps continue to limit widespread adoption. The study concludes that while AI offers substantial efficiency gains, its successful integration requires strategic planning, reliable data infrastructure, and organizational readiness.

Keywords: Artificial Intelligence, Supply Chain Management, Operational Efficiency, Demand Forecasting, Inventory Optimization, Logistics Management

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Introduction:

In today's competitive global marketplace, supply chain management must adapt quickly to fluctuations in demand, operational disruptions, and customer expectations. Traditional methods, which often rely on manual planning and limited data analysis, struggle to keep pace with these challenges. As a result, artificial intelligence (AI) has gained prominence as a tool to improve efficiency, accuracy, and responsiveness in supply chain operations (Hashmi et al., 2025).

Artificial intelligence refers to systems that can learn from data, identify patterns, and make informed decisions. In supply chain contexts, AI supports functions such as demand forecasting, inventory control, and logistics planning by providing insights that traditional approaches may overlook (Ismaeil, 2024). For example, predictive analytics and automation systems enable organizations to anticipate disruptions, optimize processes, and reduce operational costs.

Research has shown that integrating AI into supply chains enhances planning accuracy and resource utilization, leading to smoother operations and better performance outcomes (Lin, 2024; Awasthi, 2024). However, challenges such as data quality issues and the need for skilled personnel remain barriers to effective implementation (Ismaeil, 2024).

Given these insights, this study examines the role of artificial intelligence in enhancing supply chain efficiency, with a focus on key operational areas including forecasting, inventory optimization, and logistics.

Objectives:

The primary objectives of this research are:

1. To examine the role of artificial intelligence in enhancing supply chain efficiency.
2. To identify key AI applications used in supply chain functions such as forecasting, inventory management, and logistics.

3. To analyse the benefits of AI adoption in improving decision-making and operational performance.
4. To identify major challenges and research gaps related to AI implementation in supply chain management.

Research Gaps and Challenges:

Despite growing interest in AI-driven supply chains, several gaps remain in existing research. Most studies focus on large multinational organizations, while limited attention is given to small and medium-sized enterprises, particularly in developing economies. Additionally, there is a lack of empirical studies that measure long-term performance outcomes after AI implementation. From a practical perspective, organizations face challenges such as poor data quality, lack of skilled professionals, high initial investment costs, and resistance to technological change. Ethical concerns and data security issues further complicate AI adoption in supply chain systems.

Review of Literature:

Kasih, Bernadi, and Yulianti (2024) carried out a scoping review to analyze how artificial intelligence influences supply chain performance across various industries. The study revealed that machine learning and data analytics tools significantly enhance supply chain agility and cost efficiency. The authors reported that AI adoption leads to reduced lead times, improved coordination among supply chain partners, and better utilization of resources, ultimately contributing to improved operational performance.

Pal et al. (2024) conducted a comprehensive literature review examining the global impact of artificial intelligence on supply chain management. Their study highlighted that AI applications play a crucial role in improving operational efficiency by strengthening demand forecasting accuracy, optimizing inventory decisions, and enhancing logistics coordination. The authors emphasized that AI-based predictive models

enable organizations to reduce uncertainty, anticipate market fluctuations, and respond proactively to supply chain disruptions, thereby improving overall resilience.

Radhakrishnan and Shankar (2024) explored the role of predictive analytics powered by artificial intelligence in supply chain management, with a particular focus on demand forecasting. Their paper demonstrated that AI and machine learning algorithms significantly enhance the ability of firms to analyse large volumes of supply chain data, uncover patterns, and generate accurate future demand predictions. The authors emphasized that such improved forecasting precision enables organizations to better manage inventory levels, decrease waste, and align supply with fluctuating market demands, which overall strengthens supply chain responsiveness and efficiency.

Aghaei et al. (2025) examined the emerging potential of large language models in supply chain management through a conceptual and analytical review. The study emphasized that language-based AI models enhance efficiency by improving data interpretation, communication with suppliers, and scenario planning. The authors suggested that the integration of large language models with traditional AI systems can support advanced risk assessment and improve coordination across complex supply chains.

Teixeira, Ferreira, and Ramos (2025) presented a systematic literature review focusing on the contribution of artificial intelligence to intelligent supply chain management. Their findings indicated that AI technologies such as optimization algorithms and real-time data analytics improve efficiency by automating planning, scheduling, and transportation routing processes.

The authors further noted that continuous data-driven optimization supported by AI results in faster decision-making and improved service levels across supply chain networks.

Limitations of the Study:

This study is based entirely on secondary data collected from previously published research articles and reports. As a result, the findings depend on the scope and quality of existing literature. The study does not include primary data or industry-specific case studies, which may limit the generalizability of the conclusions. Additionally, rapid technological advancements may cause some findings to evolve over time.

Recommendations:

Organizations planning to adopt AI in supply chain management should invest in high-quality data infrastructure and employee skill development. A phased implementation approach can help reduce risks and resistance to change. Policymakers and researchers should focus on developing practical frameworks and guidelines tailored to small and medium enterprises. Future research should include empirical studies and real-world case analyses to better understand long-term impacts of AI adoption.

Conclusion:

Artificial intelligence has the potential to significantly transform supply chain management by enhancing efficiency, accuracy, and adaptability. This study highlights that AI applications contribute positively to forecasting, inventory control, and logistics optimization, ultimately improving overall supply chain performance. However, challenges related to data, cost, and organizational readiness must be addressed to fully realize these benefits. With appropriate strategies and continued research, AI can play a crucial role in building resilient and efficient supply chains for the future.

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