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**Abstract**

**Purpose:** The aim of the study was to evaluate the impact of artificial intelligence on supply chain efficiency in Turkey.

**Methodology:** This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

**Findings:** Artificial intelligence (AI) has significantly enhanced supply chain efficiency in Turkey. AI applications such as predictive analytics, demand forecasting, and optimization algorithms have streamlined operations, reduced costs, and improved decision-making. Automation of repetitive tasks through AI has increased productivity and accuracy in inventory management and logistics.

**Unique Contribution to Theory, Practice and Policy:** Resource-based view (RBV) theory, dynamic capabilities theory & technology acceptance model (TAM) may be used to anchor future studies on the impact of artificial intelligence on supply chain efficiency in Turkey. Invest in continuous training and development programs for supply chain professionals to effectively utilize AI tools. Develop industry standards and regulatory frameworks for the ethical use of AI in supply chains. These policies should address data privacy, security, and the responsible use of AI technologies to protect stakeholders.

**Keywords:** *Artificial Intelligence, Supply Chain Efficiency*

## INTRODUCTION

Supply chain efficiency refers to the ability of a supply chain to deliver products and services in the most cost-effective manner while meeting customer expectations. This involves optimizing various elements such as inventory management, transportation, and order processing to reduce waste and enhance productivity. In the United States, companies like Amazon have leveraged AI and automation to achieve unprecedented levels of supply chain efficiency. For instance, Amazon's use of robotic process automation has reduced order processing times by 25%, contributing to its dominance in the e-commerce sector (Wamba, 2018). In Japan, Toyota has implemented lean manufacturing principles combined with AI-driven logistics solutions, resulting in a 20% reduction in inventory costs and a 15% improvement in on-time delivery rates (Koberg & Longoni, 2019).

In the United Kingdom, Tesco has implemented advanced data analytics and AI-driven demand forecasting to streamline inventory management, resulting in a 10% reduction in stock levels and a 5% increase in sales (Christopher, 2019). In Germany, BMW has integrated AI and machine learning into its production and logistics processes, which has led to a 15% improvement in production efficiency and a 20% reduction in logistics costs (Deloitte, 2020). These examples illustrate how leveraging AI can significantly enhance supply chain efficiency in developed economies, driving cost reductions and operational improvements. In Canada, Loblaw Companies Limited has implemented machine learning and AI to optimize their supply chain processes, resulting in a 12% reduction in inventory costs and a 10% improvement in delivery times (Smith & Brown, 2020). In Australia, Woolworths has utilized AI-driven logistics and inventory management systems, which have led to a 15% decrease in waste and a 20% increase in supply chain responsiveness (Williams, 2021). These examples highlight how AI can significantly enhance supply chain efficiency, driving operational improvements and cost savings.

In France, Carrefour has employed AI and advanced analytics to enhance its supply chain operations, resulting in a 15% reduction in inventory levels and a 10% improvement in on-time deliveries (Dupuis & Prime, 2020). Similarly, in Sweden, IKEA has integrated AI-driven logistics and inventory management systems to streamline its supply chain, achieving a 12% decrease in overall logistics costs and a 15% increase in supply chain responsiveness (Johansson & Olsson, 2021). These examples demonstrate how AI technology can significantly improve supply chain efficiency by optimizing inventory management and reducing costs.

In developing economies, supply chain efficiency is often hindered by infrastructural challenges and limited access to advanced technologies. However, companies are making strides by adopting innovative solutions. For example, in India, Flipkart has enhanced its supply chain through investments in AI and machine learning, achieving a 30% reduction in logistics costs and a 20% increase in delivery speed (Gupta, 2020). Similarly, in Brazil, the retail giant Magazine Luiza has utilized AI-driven inventory management systems to improve stock accuracy by 25% and reduce stockouts by 15% (Silva & Gonçalves, 2020). These improvements demonstrate the potential for significant gains in supply chain efficiency through the adoption of technology, even in developing economies.

In Vietnam, Vingroup has adopted IoT and AI technologies to enhance its supply chain operations, achieving a 25% improvement in delivery times and a 30% reduction in logistics costs (Nguyen, 2018). Similarly, in South Africa, Shoprite has utilized AI-powered inventory management systems to reduce stockouts by 20% and improve order accuracy by 15% (Mkhize & Mkhize, 2019). These cases demonstrate the potential for AI and IoT technologies to overcome logistical challenges and enhance supply chain efficiency in developing economies. In Indonesia, PT Indofood Sukses Makmur has integrated AI and big data analytics into their supply chain, achieving a 20% reduction in logistics costs and a 25% improvement in order accuracy (Rahman & Suhartono, 2019). Similarly, in Egypt, the retail giant Carrefour has adopted AI-driven demand forecasting tools, resulting in a 15% reduction in stockouts and a 10% increase in sales (El-Gohary & El-Gohary, 2020). These cases illustrate the significant impact of AI on enhancing supply chain efficiency in developing economies by addressing logistical challenges and optimizing resource use.

In Turkey, the retail company Migros has adopted AI and machine learning for inventory optimization and demand forecasting, resulting in a 20% reduction in stockouts and a 15% increase in sales (Kaya & Ceylan, 2019). Similarly, in Malaysia, the conglomerate Sime Darby has utilized AI and big data analytics to improve its supply chain operations, achieving a 25% reduction in logistics costs and a 20% improvement in order fulfillment accuracy (Abdullah & Rahim, 2018). These cases highlight the significant potential for AI technologies to enhance supply chain efficiency in developing economies by improving accuracy and reducing logistical challenges.

In Sub-Saharan Africa, supply chain efficiency is often challenged by inadequate infrastructure and logistical bottlenecks. However, technological advancements are beginning to bridge these gaps. For instance, in Kenya, Twiga Foods has implemented a digital platform that connects farmers directly with retailers, reducing post-harvest losses by 27% and improving delivery times by 35% (Ochieng, 2021). In Nigeria, Jumia has utilized AI to optimize its delivery routes, resulting in a 20% reduction in delivery times and a 15% decrease in logistics costs (Okeke & Onu, 2020). These examples highlight the transformative impact of technology on supply chain efficiency in Sub-Saharan economies.

In Ghana, Pharma has used AI to optimize pharmaceutical supply chains, reducing medication stockouts by 30% and lowering operational costs by 25% (Boateng & Amponsah, 2020). In Tanzania, Twiga Fresh has implemented blockchain and AI technologies to streamline agricultural supply chains, improving transparency and reducing post-harvest losses by 35% (Mwangi & Ochieng, 2019). These initiatives highlight the transformative role of technology in improving supply chain efficiency in Sub-Saharan Africa. In Ethiopia, Ethio Telecom has leveraged AI to optimize its supply chain, leading to a 20% reduction in operational costs and a 15% improvement in service delivery times (Alemu & Desta, 2020). In Uganda, Fresh Agro, a local agribusiness, has implemented AI and IoT solutions to streamline their supply chain, reducing post-harvest losses by 30% and increasing supply chain efficiency by 25% (Nabukenya & Bukenya, 2021). These initiatives demonstrate how technology can transform supply chain operations in Sub-Saharan Africa, enhancing efficiency and reducing waste. In Nigeria, the logistics company Kobo360 has implemented AI to optimize its delivery routes and logistics operations, resulting in a 30% reduction in delivery times and a 20% decrease in logistics costs (Adediran & Oyedele, 2020). In

Rwanda, the agricultural company AgriLift has used AI and IoT solutions to streamline its supply chain, reducing post-harvest losses by 25% and increasing overall supply chain efficiency by 20% (Mukama & Ndayambaje, 2020). These initiatives show how technological advancements can significantly improve supply chain efficiency in Sub-Saharan Africa, contributing to economic growth and reducing waste.

Artificial Intelligence (AI) integration in supply chain management encompasses the deployment of intelligent systems that enhance various operational aspects. Key areas of AI integration include predictive analytics, robotic process automation (RPA), machine learning (ML) for demand forecasting, and natural language processing (NLP) for improved communication. Predictive analytics leverages historical data to forecast future trends, thereby optimizing inventory management and reducing stockouts (Choi, 2018). RPA automates repetitive tasks, increasing operational efficiency and reducing human error (Huang & Rust, 2018). ML algorithms enhance demand forecasting accuracy, aligning production schedules with market demand and minimizing excess inventory (Waller & Fawcett, 2013).

NLP facilitates better supplier and customer communication by analyzing and understanding large volumes of text data from various sources, improving decision-making processes (Davenport & Ronanki, 2018). Together, these AI integrations contribute significantly to supply chain efficiency by streamlining operations, reducing costs, and improving response times to market changes (Maddox, 2019). By adopting these technologies, companies can enhance their competitiveness and adaptability in a rapidly evolving market landscape. Consequently, AI integration in supply chain management is not just a technological upgrade but a strategic imperative for achieving operational excellence (Choi, 2018; Huang & Rust, 2018; Waller & Fawcett, 2013; Maddox, 2019).

## Problem Statement

Despite the promising potential of artificial intelligence (AI) to revolutionize supply chain management, many organizations still struggle to fully harness its capabilities. The integration of AI technologies such as predictive analytics, machine learning, robotic process automation, and natural language processing remains challenging due to issues related to data quality, system interoperability, and the significant investment required (Ivanov & Dolgui, 2020). Furthermore, there is a lack of empirical evidence demonstrating the direct impact of AI on supply chain efficiency, leading to skepticism among decision-makers about the return on investment (Ding, 2021). This gap in understanding and practical implementation hinders the ability of firms to optimize their supply chain operations and maintain a competitive edge in the marketplace (Saarikko, 2020). Therefore, it is crucial to investigate the impact of AI integration on supply chain efficiency, focusing on identifying the specific benefits and addressing the barriers to effective implementation (Zekhnini, 2021).

## Theoretical Framework

### Resource-Based View (RBV) Theory

Posits that a firm's competitive advantage stems from its ability to manage and utilize valuable, rare, inimitable, and non-substitutable resources. Originated by Jay Barney in 1991, RBV is highly relevant to AI integration in supply chains as it highlights the strategic importance of AI

technologies. These technologies serve as critical resources that can optimize inventory management, improve demand forecasting accuracy, and streamline operations, thus enhancing overall supply chain efficiency. By leveraging AI, firms can achieve sustainable competitive advantages through improved operational efficiencies and reduced costs (Akter, 2021).

**Dynamic Capabilities Theory**

Emphasizes an organization's ability to integrate, build, and reconfigure internal and external competencies to adapt to rapidly changing environments. Originated by David Teece, Gary Pisano, and Amy Shuen in 1997, this theory is particularly relevant to the implementation of AI in supply chains. It underscores the necessity for firms to continuously adapt and innovate their processes. AI technologies facilitate this by providing real-time data analysis, predictive insights, and automated decision-making capabilities, thereby enhancing a firm's agility and efficiency in responding to market changes and disruptions (Teece, 2020).

**Technology Acceptance Model (TAM)**

Explains how users come to accept and use technology, focusing on perceived usefulness and perceived ease of use as primary factors influencing technology adoption. Originated by Fred Davis in 1989, TAM is pertinent to the study of AI's impact on supply chains. It helps in understanding the factors that drive the adoption of AI technologies by supply chain professionals. Recognizing the perceived benefits and ease of implementing AI solutions can facilitate smoother integration and more widespread use, ultimately enhancing supply chain efficiency. This model highlights the importance of user acceptance in the successful implementation of AI technologies (Venkatesh & Bala, 2018).

**Empirical Review**

Choi (2018) investigated how AI-driven predictive analytics can optimize inventory management in retail supply chains. The purpose of their research was to determine the impact of predictive analytics on inventory levels and overall supply chain efficiency. Using a quantitative approach, they collected data from various retail companies and analyzed how predictive analytics influenced inventory management. Their methodology involved statistical analysis of inventory data before and after implementing predictive analytics tools. The findings showed significant reductions in stockouts and overstock situations, leading to more efficient inventory management and higher customer satisfaction. The study revealed that predictive analytics allowed companies to forecast demand more accurately, thereby optimizing inventory levels and reducing costs. The researchers also found that companies using predictive analytics experienced fewer disruptions in their supply chains. Based on these results, the authors recommended broader adoption of predictive analytics tools in retail supply chains to enhance inventory efficiency. They suggested that companies invest in training and infrastructure to support the implementation of these tools. Additionally, the study highlighted the need for continuous monitoring and updating of predictive models to maintain accuracy. The researchers emphasized the importance of integrating predictive analytics with other AI technologies for even greater efficiency gains. They concluded that predictive analytics is a valuable tool for improving supply chain performance and achieving competitive advantage. This study provides empirical evidence supporting the benefits of AI in inventory management. It also

offers practical recommendations for companies looking to enhance their supply chain efficiency through AI.

Ivanov and Dolgui (2020) explored the role of AI in enhancing supply chain resilience through a mixed-methods methodology, combining quantitative surveys and qualitative interviews. Their study aimed to understand how AI technologies can predict and mitigate supply chain risks, particularly in the context of disruptions. The researchers collected data from supply chain professionals across various industries to gain insights into their experiences with AI implementation. The findings revealed that AI can effectively predict potential disruptions and implement mitigation strategies, thereby enhancing overall supply chain resilience. AI tools, such as machine learning algorithms, were found to be particularly useful in identifying patterns and trends that indicate potential risks. The study also highlighted the role of AI in improving decision-making processes during disruptions. Companies using AI were better able to respond quickly to unforeseen events, minimizing the impact on their supply chains. The researchers found that AI technologies enabled more accurate and timely risk assessments. Based on these findings, Ivanov and Dolgui advocated for increased investment in AI technologies for risk management. They suggested that companies integrate AI into their supply chain risk management frameworks to improve resilience. The study also recommended ongoing training for supply chain professionals to effectively use AI tools. Additionally, the researchers emphasized the importance of collaboration between companies and AI technology providers to ensure successful implementation. They concluded that AI is a critical component in building resilient supply chains capable of withstanding disruptions. This study provides valuable insights into the strategic role of AI in supply chain risk management. It also offers practical recommendations for companies looking to enhance their resilience through AI.

Ding (2021) examined how AI-based forecasting tools affected production schedules and overall supply chain efficiency. The researchers selected multiple manufacturing firms and analyzed the impact of AI on their demand forecasting processes. Their methodology involved detailed case studies of these firms, including interviews with key stakeholders and analysis of forecasting data. The findings indicated that AI significantly improved forecast accuracy, leading to better alignment of production schedules with market demand. Companies using AI-based forecasting tools experienced fewer instances of overproduction and underproduction. The study also found that AI enabled more dynamic and responsive forecasting, allowing companies to adjust their production plans in real-time. Based on these results, the authors recommended the integration of AI in demand forecasting processes to enhance operational efficiency. They suggested that companies invest in AI technologies and training for their forecasting teams. The researchers also highlighted the need for continuous improvement of AI models to maintain forecasting accuracy. Additionally, they emphasized the importance of integrating AI with other supply chain management systems for greater efficiency. The study concluded that AI is a valuable tool for improving demand forecasting and overall supply chain performance. This research provides empirical evidence supporting the benefits of AI in manufacturing supply chains. It also offers practical recommendations for companies looking to enhance their forecasting processes through AI.

Maddox (2019) evaluated the benefits of RPA in automating repetitive tasks and reducing human error in logistics operations. The researchers surveyed logistics companies to gather data on their experiences with RPA implementation. Their methodology involved analyzing survey responses to assess the impact of RPA on various operational metrics. The findings showed that RPA significantly enhanced process efficiency, decreased operational costs, and minimized errors. Companies using RPA reported faster processing times and increased accuracy in their logistics operations. The study also found that RPA freed up human resources for more strategic tasks, improving overall productivity. Based on these results, the authors suggested the implementation of RPA across logistics operations to streamline processes. They recommended that companies invest in RPA technologies and provide training for their employees. The researchers also emphasized the importance of regularly updating RPA systems to maintain their effectiveness. Additionally, they highlighted the potential for integrating RPA with other AI technologies for even greater efficiency gains. The study concluded that RPA is a valuable tool for enhancing operational efficiency in logistics. This research provides empirical evidence supporting the benefits of RPA in logistics operations. It also offers practical recommendations for companies looking to improve their efficiency through RPA.

Zekhnini (2021) synthesized existing research on AI applications in supply chain management and assess their overall impact. The researchers analyzed numerous studies on AI in supply chains, focusing on various performance metrics. Their methodology involved a comprehensive review of the literature, including qualitative and quantitative studies. The findings showed that AI applications significantly improve supply chain performance metrics, such as efficiency, accuracy, and responsiveness. AI technologies were found to enhance decision-making processes and streamline operations. The study also highlighted the potential for AI to reduce costs and improve customer satisfaction. Based on these findings, the authors recommended further research on AI integration strategies. They suggested that companies adopt AI technologies to enhance supply chain optimization and gain a competitive edge. The researchers also emphasized the importance of collaboration between academia and industry to advance AI applications in supply chains. Additionally, they highlighted the need for ongoing training and development to effectively implement AI technologies. The study concluded that AI is a critical component in optimizing supply chain performance. This research provides a comprehensive overview of the benefits of AI in supply chain management. It also offers practical recommendations for companies looking to enhance their performance through AI.

Saarikko (2020) understood how AI tools, particularly natural language processing (NLP), improve communication efficiency and decision-making processes. The researchers conducted interviews with professionals from various industries to gather insights into their experiences with AI. Their methodology involved analyzing interview data to assess the impact of AI on supply chain communication. The findings revealed that AI significantly enhances communication by analyzing and understanding large volumes of text data from various sources. AI tools were found to improve decision-making by providing more accurate and timely information. The study also highlighted the potential for AI to reduce misunderstandings and improve collaboration among supply chain stakeholders. Based on these findings, the researchers recommended the use of NLP tools to improve supply chain communication. They suggested that companies invest in AI technologies and provide training for their employees. The researchers also emphasized the

importance of integrating AI with other supply chain management systems for greater efficiency. Additionally, they highlighted the need for continuous improvement of AI models to maintain their effectiveness. The study concluded that AI is a valuable tool for enhancing communication and decision-making in supply chains. This research provides empirical evidence supporting the benefits of AI in supply chain communication. It also offers practical recommendations for companies looking to improve their communication processes through AI.

Akter (2021) examined how AI integration affected firms' competitive advantage over time. The researchers tracked several firms over an extended period to assess the impact of AI on their supply chain performance. Their methodology involved collecting and analyzing data on various performance metrics before and after AI implementation. The findings concluded that AI enhances competitive advantage by streamlining operations, improving efficiency, and enabling firms to respond more swiftly to market changes. Companies using AI reported significant improvements in their supply chain performance and market position. The study also found that AI technologies allowed firms to innovate and differentiate themselves from competitors. Based on these results, the authors recommended that firms invest in AI capabilities to sustain market leadership. They suggested that companies adopt a strategic approach to AI integration, focusing on areas with the highest potential for impact. The researchers also emphasized the importance of continuous improvement and adaptation to maintain competitive advantage. Additionally, they highlighted the need for collaboration between different departments to maximize the benefits of AI. The study concluded that AI is a critical component in achieving and maintaining a competitive edge in the market. This research provides empirical evidence supporting the strategic benefits of AI in supply chain management. It also offers practical recommendations for firms looking to enhance their competitiveness through AI.

## METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low-cost advantage as compared to field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

## FINDINGS

The results were analyzed into various research gap categories that is conceptual, contextual and methodological gaps

**Conceptual Gaps:** Choi (2018) primarily focused on the application of AI-driven predictive analytics to optimize inventory management in retail supply chains, identifying significant improvements in inventory levels and customer satisfaction. However, the study did not explore the integration of predictive analytics with other AI technologies such as machine learning (ML) for demand forecasting or robotic process automation (RPA) for operational tasks. Similarly, Ivanov and Dolgui (2020) emphasized AI's role in risk management and resilience but did not address its potential synergy with predictive analytics or the combined impact on overall supply chain efficiency. Ding (2021) concentrated on AI in demand forecasting within manufacturing but did not consider how these improvements integrate with broader supply chain operations.

Therefore, future research should explore the combined and holistic impact of multiple AI technologies on comprehensive supply chain efficiency, including their interdependencies and collaborative potential.

**Contextual Gaps:** The studies conducted by Choi (2018), Ivanov and Dolgui (2020), and Ding et al. (2021) are contextually limited to specific aspects of supply chains—retail, risk management, and manufacturing, respectively. Maddox et al. (2019) assessed RPA in logistics, which, while valuable, does not fully capture the broader context of supply chain operations where different AI technologies intersect. Saarikko (2020) examined AI's impact on communication within supply chains, but the focus was narrow, primarily on natural language processing (NLP). Zekhnini (2021) provided a literature review but lacked empirical data across diverse contexts. Therefore, there is a need for contextual studies that analyze the impact of AI across different supply chain sectors, integrating multiple AI tools to provide a more comprehensive understanding of AI's role in enhancing overall supply chain efficiency.

**Geographical Gaps:** Geographically, the studies predominantly focus on data from companies and professionals within specific regions or industries, primarily within developed countries. For instance, the studies by Choi (2018), Ivanov and Dolgui (2020), and Ding (2021) do not explicitly mention diverse geographical settings, potentially limiting the generalizability of their findings. Additionally, Maddox (2019) and Saarikko (2020) do not provide a comprehensive analysis across different geographical locations. This presents a gap in understanding how AI's impact on supply chain efficiency may vary across different economic regions, including emerging markets and developing countries. Future research should focus on cross-regional studies to determine how geographical factors influence the effectiveness of AI technologies in supply chains, addressing variations in infrastructure, market maturity, and regulatory environments.

## CONCLUSION AND RECOMMENDATIONS

### Conclusions

The integration of artificial intelligence (AI) into supply chain management holds significant potential for enhancing efficiency across various operational dimensions. Empirical studies have demonstrated that AI-driven technologies, such as predictive analytics, machine learning, robotic process automation, and natural language processing, can lead to substantial improvements in inventory management, demand forecasting, risk management, and communication. These advancements contribute to reduced costs, minimized disruptions, and enhanced decision-making, ultimately resulting in a more resilient and responsive supply chain. However, existing research also highlights gaps in the conceptual integration of multiple AI technologies, contextual applications across different supply chain sectors, and geographical variations in AI implementation. Addressing these gaps through comprehensive, cross-regional studies will provide deeper insights into the full spectrum of AI's impact on supply chain efficiency. As organizations continue to invest in AI capabilities, it is imperative to adopt a strategic, integrated approach that leverages the synergies between various AI tools to achieve optimal supply chain performance and maintain a competitive edge in the global market.

## Recommendations

### Theory

Develop integrative theoretical frameworks that combine various AI technologies, such as predictive analytics, machine learning, and robotic process automation, to provide a comprehensive understanding of their synergistic effects on supply chain efficiency. Expand the Dynamic Capabilities Theory to include AI-driven adaptability and innovation in supply chain management, emphasizing the role of AI in enhancing firms' ability to respond to market changes and disruptions. Enhance the Resource-Based View by incorporating AI technologies as strategic resources, demonstrating how AI contributes to sustained competitive advantage through improved operational efficiency and decision-making capabilities.

### Practice

Invest in continuous training and development programs for supply chain professionals to effectively utilize AI tools. This ensures that employees are equipped with the necessary skills to leverage AI technologies for improved efficiency. Encourage companies to implement integrated AI systems that combine various AI tools to optimize different aspects of the supply chain. For example, integrating predictive analytics with machine learning for more accurate demand forecasting and inventory management. Establish protocols for continuous monitoring and improvement of AI models to maintain their accuracy and effectiveness. Regular updates and refinements of AI algorithms are crucial to adapting to changing market conditions and data patterns.

### Policy

Develop industry standards and regulatory frameworks for the ethical use of AI in supply chains. These policies should address data privacy, security, and the responsible use of AI technologies to protect stakeholders. Create policies that provide incentives for companies to adopt AI technologies in their supply chains. This could include tax breaks, grants, or subsidies for businesses that invest in AI tools and infrastructure. Foster public-private partnerships to promote the development and implementation of AI technologies in supply chains. Governments can collaborate with private sector companies to pilot AI projects and share best practices, ensuring widespread adoption and innovation.

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