

The Impact of Artificial Intelligence on Logistics Operations at NAQEL Express in Saudi Arabia

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Introduction

In today's rapidly evolving business environment, the integration of modern technologies like artificial intelligence (AI) has become indispensable across various industries, particularly in logistics. Logistics companies face the ongoing challenge of managing complex global supply chains while striving to reduce costs and enhance customer satisfaction. Embracing AI offers a strategic pathway for these firms to achieve these goals effectively (Hofmann & Rüscher, 2017).

NAQEL Express, a prominent player in the logistics sector and owned by Saudi Post logistics, stands out for its proactive approach in adopting cutting-edge technologies to improve service delivery and elevate customer experiences. AI plays a pivotal role within NAQEL Express by optimizing critical aspects of operations such as route planning, warehouse management, and decision-making processes. This strategic deployment of AI enables the company to achieve higher levels of operational efficiency and accuracy in logistics management (Sternberg & Andersson, 2014).

The impact of AI in logistics extends across several vital areas. One significant benefit lies in predictive analytics, which empowers companies to forecast demand more accurately. By analyzing historical data, market trends, and external factors, AI-driven algorithms enhance inventory management by optimizing stock levels and

reducing unnecessary stockpiling, thereby minimizing wastage and improving cost efficiency (Wang et al., 2016). Moreover, AI's capability to analyze vast datasets enables logistics companies like NAQEL Express to optimize shipping routes based on real-time traffic conditions, weather forecasts, and delivery schedules. This not only reduces delivery times and fuel consumption but also enhances overall service reliability and customer satisfaction (Melo et al., 2017).

Automation facilitated by AI in warehouse operations is another transformative application. Automated systems and robots streamline tasks such as picking, packing, and sorting, thereby minimizing errors and increasing throughput rates. This automation allows human workers to focus on more complex tasks that require human judgment and creativity, further improving operational efficiency and reducing labor costs (Kumar et al., 2019).

Customer service is also significantly enhanced through AI-powered chatbots and virtual assistants. These technologies provide round-the-clock support, handling inquiries, tracking shipments, and resolving issues promptly. By automating these routine tasks, NAQEL Express can ensure consistent and efficient customer service, thereby enhancing overall customer satisfaction and loyalty (Huang & Rust, 2018).

Furthermore, AI's role in monitoring transactions and detecting anomalies contributes to enhanced security and fraud prevention. By continuously analyzing

transactional data and identifying unusual patterns, AI systems help mitigate risks and protect the company's assets and reputation. This proactive approach to security not only safeguards NAQEL Express's operations but also fosters trust and confidence among its customers (Bose & Mahapatra, 2021).

In conclusion, NAQEL Express's strategic integration of AI technologies position the company at the forefront of innovation in logistics. By leveraging AI to optimize operations, improve decision-making processes, and enhance customer interactions, NAQEL Express not only enhances its operational efficiency but also strengthens its competitive edge in the dynamic logistics industry landscape. This study aims to delve deeper into how AI is transforming NAQEL Express's logistics operations, highlighting the tangible benefits and strategic advantages that AI adoption brings to the company.

Research Problem

The research problem revolves around the significant challenges faced by logistics companies, especially NAQEL Express in Saudi Arabia, in their efforts to improve operational efficiency and enhance supply chain performance using artificial intelligence. These challenges include the increasing complexities of global supply chain management, the need to achieve high levels of operational efficiency,

the integration of different technological systems, and the need to balance operational performance with environmental sustainability goals.

Research Importance

1. Theoretical Importance:

- **Operational Efficiency Analysis:** The research helps understand and analyze the factors affecting operational efficiency in logistics companies, contributing to the development of new theories or the improvement of existing theories on logistics operations management.
- **Case Studies of Specific Companies:** The research provides a detailed case study of NAQEL Saudi Arabia, which can be used as a model to analyze the performance of similar logistics companies in the region.
- **Advanced Technology in Logistics:** The research contributes to expanding theoretical knowledge on how to integrate advanced technology into logistics operations and the expected benefits from this integration.
- **Sustainability in Logistics:** The research helps develop a theoretical framework on how to enhance sustainability in supply chains and logistics services, supporting global trends towards sustainable development.

2. Practical Importance:

- **Improving Operational Efficiency:** Logistics companies like NAQEL can use the findings and recommendations to improve their operational efficiency, leading to cost reduction and increased profitability.
- **Enhancing Supply Chain Performance:** The results provide practical tools and strategies to improve performance in supply chains, ensuring smoother and more efficient product and service flow.
- **Integrating Advanced Technology:** Companies can use the findings to identify the best ways to integrate advanced technologies such as artificial intelligence and robotics into their operations, enhancing productivity and accuracy.
- **Enhancing Sustainability:** The findings offer practical solutions to enhance sustainability, such as reducing carbon emissions and improving resource management, positively impacting the environment and society.

Research Objectives

- Analyze the challenges in logistics operations faced by NAQEL Express in Saudi Arabia.
- Evaluate the impact of artificial intelligence on enhancing efficiency and performance in logistics services at NAQEL Express in Saudi Arabia.

- Explore strategies for integrating artificial intelligence into logistics processes to improve effectiveness.
- Assess the role of artificial intelligence in optimizing supply chain management and logistics operations.
- Provide actionable recommendations for NAQEL Express in Saudi Arabia to effectively leverage artificial intelligence for sustainable growth and competitive advantage.

Research Questions

1. How does artificial intelligence (AI) improve efficiency and performance in logistics operations at NAQEL Express?
2. What are the key challenges NAQEL Express faces in integrating AI into its logistics processes?
3. What strategies can NAQEL Express adopt to effectively leverage AI for optimizing supply chain management?

Hypotheses

1. There is a positive and significant relationship between the application of smart technology in logistics operations and its efficiency.
2. There is a positive and significant impact of the application of smart technology on customer satisfaction with logistics services.
3. The application of smart technology in logistics operations is accompanied by a reduction in the operational costs of the company.

Review of Literature

(Faccenda, 2022) conducted a study titled "Measuring the Sustainability Impact of Artificial Intelligence in Logistics: A Case Study Analysis". The objective of the study was to analyze methods for assessing the sustainability impact of AI in logistics, focusing on environmental, social, and economic impacts. It aims to understand how AI solutions can contribute to reducing environmental and societal impacts while meeting the increasing demand for goods and services in logistics. The study analyzes the sustainability improvements brought about by AI in logistics through methods such as evaluating key performance indicators (KPIs) and conducting case study analyses. It explores how AI optimizes various aspects of logistics operations, including transportation, inventory management, warehouse management, and delivery. The research highlights that AI in logistics offers benefits

such as vehicle routing optimization, improved truck utilization, real-time route adjustments, risk and hazard identification, and predictive maintenance. However, it also identifies barriers to measuring sustainability impacts, such as the lack of integrated systems, advanced technologies and analytics, data governance frameworks, organizational changes, and limited financial incentives. Despite these challenges, evaluating the sustainability impacts of AI solutions is crucial for fostering more sustainable and responsible business practices in logistics.

(Balfaqih, 2023) conducted a study titled "Artificial Intelligence and Smart Logistics Systems in Industry". The aim of this study is to analyze the variables influencing smart logistics and to evaluate the effectiveness of artificial intelligence (AI) applications in enhancing smart logistics within the context of Industry 4.0. The study seeks to explore the technological applications of AI and examine the factors that drive the adoption of AI in smart logistics. The study employs a comprehensive analysis to investigate the impact of AI on smart logistics. It examines variables affecting the adoption of AI technologies and integrates findings from technology and AI studies relevant to smart logistics. The research assesses the efficiency of AI applications by integrating various technologies such as big data, Internet of Things (IoT), and cloud computing. The findings indicate that AI applications significantly impact industrial organizations and businesses through enhanced communication and information technology in large-scale smart logistics systems. AI facilitates

technological advancements in supply chain logistics by integrating capabilities in big data management, IoT integration, and cloud computing services.

(Alheadary, 2024, p. 161-168) conducted a study titled "The impacts of the internet of things and artificial intelligence on logistics in supply chain management". The objective of this study is to introduce and analyze a new approach called IoT-AI-SCM, which integrates the Internet of Things (IoT) and artificial intelligence (AI) for supply chain management. This approach aims to address the current gap in academic literature where the combination of IoT and AI is often overlooked in strategies and structures for overseeing the movement and storage of goods. The study employs the design science method to develop and implement the IoT-AI-SCM approach. This method involves five key steps: 1) utilizing sensors and devices enabled by IoT, 2) gathering and connecting data, 3) storing and processing data using cloud technology, 4) applying AI, and 5) analyzing and predicting outcomes, and 6) smart planning and improvement. The research indicates that implementing this approach can significantly transform supply chain and logistics management. By leveraging the essential features of IoT and AI, companies can enhance their capabilities in data collection, processing, and analysis, leading to improved decision-making and efficiency. The study outlines how this approach enables a reimagined supply chain management system that integrates advanced technologies to optimize operations and predict outcomes more accurately.

(Louis & Hubert, 2024) conducted a study entitled "The Impact of Artificial Intelligence on Logistics Decision Making". In this study, the aim was to explore how advancements in artificial intelligence (AI) impact decision-making processes in logistics, highlighting their profound effects, challenges, and opportunities. The research discusses how AI technologies such as machine learning, predictive analytics, and natural language processing empower logistics professionals with advanced tools to enhance decision-making efficiency and accuracy. It also addresses the optimization of resource allocation, predictive maintenance, and risk management in supply chain operations using AI algorithms. AI technologies such as machine learning, predictive analytics, and natural language processing have revolutionized logistics decision making by enhancing efficiency, accuracy, and agility. They optimize resource allocation by analyzing transportation costs, inventory levels, and demand patterns, thereby improving cost-effectiveness and minimizing environmental impact. The study indicated that AI enables predictive maintenance to reduce downtime and optimize asset utilization, while AI-driven risk management systems identify and mitigate supply chain disruptions proactively. Despite these benefits, challenges like data privacy concerns and the need for workforce upskilling remain, necessitating regulatory frameworks and ethical guidelines for responsible AI deployment in logistics.

(Villanueva-Eslava, *et al.*, 2024) conducted a study titled "Artificial intelligence and logistics services: a systematic literature review". The objective of the study was to identify the artificial intelligence tools utilized and their impact on logistics services, achieved through a systematic review of scientific literature. Fifteen articles were selected from the Proquest and Scopus databases using terms such as artificial intelligence AND Logistics AND contracts OR provision OR services. The study found utilization of technologies including Blockchain, IoT, smart contracts, deep learning, and computer software in logistics services. It was concluded that digitization involves integrating artificial intelligence into logistics services, with IoT prominently featured, while deep learning is less common in this context compared to other technologies. Artificial intelligence tools were found to impact logistics services by optimizing supply chains, enhancing product identification and tracking, and improving efficiency in contracting and transportation processes. The study recommends that logistics service providers in Latin America adopt artificial intelligence tools to improve the services they offer, considering the growing trends of AI adoption in logistics services observed in Europe, Asia, and North America.

Study Definitions

- **Artificial Intelligence (AI):** Refers to the simulation of human intelligence by computer systems, including tasks such as learning, reasoning, problem-solving, and decision-making. AI technologies may include machine learning, natural language processing, and computer vision (Russell & Norvig, 2021).
- **Logistics Operations:** Encompasses all activities involved in the management and movement of goods and resources from point of origin to consumption. This includes transportation, warehousing, inventory management, and distribution (Chopra & Meindl, 2021).
- **Supply Chain Management:** Involves the planning, coordination, and control of the flow of goods, services, information, and finances across the supply chain from suppliers to end customers. AI in supply chain management improves visibility, forecasting, and responsiveness to market changes (Chopra & Meindl, 2021).
- **Predictive Analytics:** Utilizes statistical algorithms and machine learning techniques to analyze current and historical data to make predictions about future events or behaviors. In logistics, predictive analytics helps in demand forecasting, resource allocation, and risk management (Montgomery, *et al.*, 2012).

Theoretical premises of the study

- 1. Resource Theory Existing (RBV):** The Resource-Based View (RBV) is a theory that posits that a company's unique and valuable resources can provide it with a competitive advantage. According to Barney (1991), resources that are valuable, rare, inimitable, and non-substitutable can enable a company to achieve and sustain superior performance. In the context of NAQEL Express, AI is considered a valuable resource that can enhance various aspects of logistics operations. By leveraging AI, NAQEL Express can improve process efficiency, optimize routes, enhance predictive maintenance, and ultimately increase customer satisfaction. This theory helps to understand how NAQEL Express can use its AI capabilities to gain a competitive edge in the logistics industry.
- 2. Technology Acceptance Model (TAM):** The Technology Acceptance Model (TAM) was developed by Davis (1989) to explain how users come to accept and use a technology. TAM suggests that two main factors influence technology acceptance: perceived usefulness and perceived ease of use. Perceived usefulness is the degree to which a person believes that using a particular system would enhance their job performance, while perceived ease of use refers to the degree to which a person believes that using the system would be free of effort. In the case of NAQEL Express, TAM is used to analyze how employees and managers perceive the application of AI in their logistics operations.

Understanding these perceptions can help NAQEL Express address any concerns, improve training programs, and ensure a smoother integration of AI technologies into their workflows.

3. Systems Theory: Systems Theory, introduced by Bertalanffy (1968), emphasizes the interdependence and interaction of various subsystems within an organization. According to this theory, an organization can be viewed as a complex system composed of interconnected subsystems, each of which plays a crucial role in the overall functionality and success of the organization. When applying Systems Theory to NAQEL Express, the focus is on how the integration of AI impacts different components of logistics operations, such as inventory management, transportation, and customer service. By viewing NAQEL Express as a system, the study can examine how AI integration affects the entire logistics network, identify potential synergies, and address any disruptions that may arise during the implementation process. Systems Theory helps in understanding the holistic impact of AI on NAQEL Express's logistics operations, ensuring that the integration enhances overall organizational efficiency and effectiveness.

Methodology and research methods

Study Methodology:

The study follows the descriptive-analytical approach aimed at describing and analyzing the impact of artificial intelligence on logistics operations at NAQEL Express. The descriptive-analytical approach allows for understanding the relationship between independent and dependent variables and evaluating how smart technology applications can improve operational efficiency, customer satisfaction, and reduce operational costs.

Research Methods:

- 1. Data Sources:** Primary Data: Data will be collected from employees and managers at NAQEL Express through questionnaires and personal interviews.
- 2. Secondary Data:** Annual reports, company documents, and relevant academic articles will be used.

Research Tools:

Questionnaire: A questionnaire divided into several sections to cover different aspects of the study (smart technology applications, logistics operational efficiency, customer satisfaction, and operational costs).

Statistical Analysis:

- **Descriptive Analysis:** Descriptive analysis will be used to characterize demographic data and responses to the questionnaire.
- **Inferential Analysis:** Regression analysis, T-test, and Analysis of Variance (ANOVA) will be used to analyze hypotheses and test relationships between variables.

Limitations of the study

- **Temporal limits:** The study extends from the beginning of the use of intelligent technology in NAQEL Express operations to the present.
- **Spatial Research:** The study focuses on NAQEL Express's logistics operations in Saudi Arabia.
- **Objectivity:** The study includes assessing the effects of the use of artificial intelligence on the efficiency of operations and logistics performance.

Conclusion

In conclusion, the integration of artificial intelligence (AI) into logistics operations at NAQEL Express represents a transformative opportunity to enhance efficiency, accuracy, and decision-making throughout the supply chain. By embracing AI technologies such as machine learning, predictive analytics, and autonomous systems, NAQEL Express can significantly optimize resource allocation, improve forecasting capabilities, and streamline logistics processes from warehousing to distribution. This strategic adoption not only enhances operational effectiveness but also positions NAQEL Express competitively in the dynamic logistics industry landscape. The implementation of AI allows for substantial improvements in efficiency and accuracy, as machine learning algorithms analyze vast amounts of data in real-time, enabling precise demand forecasting and proactive disruption mitigation. AI-driven optimization tools enhance resource allocation by suggesting the most efficient routes and optimizing storage space, while predictive analytics refine forecasts dynamically, allowing for effective planning. Moreover, AI automates repetitive tasks and enhances decision-making, leading to increased productivity and reduced risks. By leveraging these advancements, NAQEL Express strengthens its competitive position, offering faster, more reliable, and cost-effective logistics solutions. As AI continues to evolve, its applications promise further advancements in efficiency and sustainability, reinforcing NAQEL Express's

commitment to innovation and excellence in service delivery, and ensuring the company remains a leader in the logistics sector.

Results

The implementation of artificial intelligence (AI) in logistics operations at NAQEL Express in Saudi Arabia is anticipated to yield significant benefits, including enhanced operational efficiency, improved decision-making capabilities, increased customer satisfaction, cost savings through optimized resource allocation, and strengthened innovation and competitive edge in the logistics sector. Based on the hypotheses, the study is expected to show a positive and significant relationship between the application of smart technology and the efficiency of logistics operations. The use of AI and IoT technologies is predicted to enhance the accuracy of forecasts and operational processes, leading to better resource management and reduced downtime. Additionally, the application of smart technology is anticipated to have a substantial positive impact on customer satisfaction by improving delivery accuracy, reducing errors, and increasing responsiveness to customer needs, thereby enhancing the overall customer experience and satisfaction with logistics services. Furthermore, the study is likely to demonstrate that the integration of smart technology in logistics operations results in a reduction in operational costs through improved resource utilization, reduced errors, and enhanced process efficiency,

which in turn boosts profitability. Overall, the anticipated results suggest that AI integration at NAQEL Express will significantly boost operational efficiency, customer satisfaction, and cost-effectiveness, thereby fortifying the company's position in the competitive logistics market.

Recommendations

- **Develop a Strategic AI Plan:** NAQEL Express should prioritize the development of a comprehensive AI strategy tailored to its logistics objectives. This plan should outline clear goals for enhancing operational efficiency and improving customer service through the strategic deployment of AI technologies. By aligning AI initiatives with business objectives, NAQEL Express can maximize the benefits of AI implementation in logistics.
- **Prioritize Data Integration:** Investing in robust systems for data integration and management is crucial for the successful implementation of AI. NAQEL Express should ensure that its AI algorithms have access to accurate and comprehensive data from various sources within the logistics ecosystem. This includes real-time data on shipments, inventory levels, customer preferences, and operational metrics. By prioritizing data integration, NAQEL Express can enhance the accuracy and effectiveness of AI-driven decision-making processes.

- **Implement AI for Predictive Maintenance:** Leveraging AI-driven predictive maintenance can significantly reduce downtime and optimize resource management in logistics operations. NAQEL Express should implement AI algorithms to predict and prevent equipment failures, optimize maintenance schedules, and improve asset utilization. This proactive approach not only minimizes disruptions but also enhances operational reliability and cost-efficiency.
- **Enhance AI Utilization in Postal Services:** To improve service efficiency and customer satisfaction in mail distribution and delivery operations, NAQEL Express should expand the use of smart technologies such as AI. This includes employing AI algorithms for route optimization, real-time tracking, and delivery scheduling. By enhancing AI utilization in postal services, NAQEL Express can streamline operations, reduce delivery times, and enhance overall service quality.
- **Invest in AI Training and Development:** To fully capitalize on AI's potential, NAQEL Express should invest in training programs and skill development for its workforce. This includes training logistics professionals on AI tools and technologies, fostering a culture of innovation and continuous learning. By building internal AI capabilities, NAQEL Express can empower its teams to leverage AI effectively and drive sustainable growth in the logistics sector.

- **Monitor and Evaluate AI Performance:** Continuous monitoring and evaluation of AI performance are essential to refine strategies and ensure ongoing improvements. NAQEL Express should establish metrics and KPIs to assess the impact of AI on operational efficiency, customer satisfaction, and cost savings. Regular evaluations will enable NAQEL Express to adapt AI strategies based on real-time feedback and market dynamics, ensuring long-term success and competitive advantage.

By implementing these recommendations, NAQEL Express can position itself as a leader in AI-driven logistics innovation, delivering enhanced efficiency, superior customer service, and sustainable growth in the competitive logistics industry.

References

- Barney, J. (1991). **Firm resources and sustained competitive advantage.** *Journal of Management*, 17(1), 99-120.
- Bertalanffy, L. (1968). **General System Theory: Foundations, Development, Applications.** George Braziller.
- Chopra, S., & Meindl, P. (2021). **Supply Chain Management: Strategy, Planning, and Operation** (8th ed.). Pearson.
- Davis, F. D. (1989). **Perceived usefulness, perceived ease of use, and user acceptance of information technology.** *MIS Quarterly*, 13(3), 319-340.
- Louis F., & Hubert K. (2024). **The Impact of Artificial Intelligence on Logistics Decision Making.** at: <https://www.researchgate.net/publication/380320025>
- Montgomery, D. C., Peck, E. A., & Vining, G. G. (2012). **Introduction to Linear Regression Analysis** (5th ed.). Wiley.
- Russell, S. J., & Norvig, P. (2021). **Artificial Intelligence: A Modern Approach** (4th ed.). Pearson.
- Villanueva-Eslava, A., Riega-Virú, Y., Nilupu-Moreno, K., & Salas-Riega, J. L. (2024). **Artificial intelligence and logistics services: a systematic literature review.** DOI: 10.1109/ICALTER61411.2023.10372911

Hofmann, E., & Rüsch, M. (2017). **Industry 4.0 and the current status as well as future prospects on logistics.** *Computers in Industry*, 89, 23-34.

Sternberg, H., & Andersson, M. (2014). **Decentralized intelligence in transport operations: The capacity of self-organizing systems.** *International Journal of Physical Distribution & Logistics Management*, 44(10), 738-758.

Wang, G., Gunasekaran, A., Ngai, E. W. T., & Papadopoulos, T. (2016). **Big data analytics in logistics and supply chain management: Certain investigations for research and applications.** *International Journal of Production Economics*, 176, 98-110.

Melo, S., Baptista, P., & Costa, Á. (2017). **Comparing the use of small and medium-size urban freight vehicles: A case study in Lisbon.** *Transportation Research Procedia*, 25, 785-796.

Kumar, A., Singh, R. K., & Shankar, R. (2019). **Critical success factors for implementing sustainable supply chain management practices: An empirical study of Indian automobile industry.** *Engineering Applications of Artificial Intelligence*, 76, 156-169.

Huang, M.-H., & Rust, R. T. (2018). **Artificial intelligence in service.** *Journal of Service Research*, 21(2), 155-172.

Bose, I., & Mahapatra, R. K. (2021). **Business data mining - a machine learning perspective.** *Information & Management*, 39(3), 211-225.

Faccenda, G. (2022). **Measuring the Sustainability Impact of Artificial Intelligence in Logistics: A Case Study Analysis.** Tesi Di Laurea Magistrale in Management Engineering. POLITECNICO, MILANO 1863.

Balfaqih, H. (2023). **Artificial Intelligence and Smart Logistics Systems in Industry.** *Proceedings of the International Conference on Industrial Engineering and Operations Management Manila, Philippines.*

Alheadary, W. G. (2024). **The impacts of the internet of things and artificial intelligence on logistics in supply chain management.** *International Journal of Advanced and Applied Sciences*, 11(1), P: 161-168.