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THE USE OF ARTIFICIAL INTELLIGENCE IN LOGISTICS

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Abstract

Technological developments aiming at increasing efficiency, accuracy, and cost-effectiveness are causing a rapid change in the worldwide logistics industry, which is valued at over 4.3 trillion USD. This development is greatly supported by artificial intelligence (AI), which makes robotic automation, real-time tracking, and predictive analytics possible. The article analyses how artificial intelligence (AI) influences logistics, highlighting its advantages, adoption barriers, and ways to reduce expenses. By improving route planning, inventory control, and warehouse automation while lowering operational costs and human error, AI-driven solutions improve supply chain operations. However, barriers including high implementation costs, cybersecurity risks, and employee dislocation limit widespread adoption. This study investigates the ways in which demand forecasting, predictive analytics, and AI-driven automation enhance logistics cost effectiveness using secondary research and content analysis. The results show that integrating AI enhances operational performance and reduces costs, but it also calls for workforce adaptability and strategic investment. To effectively utilize AI's potential for long-term growth in the logistics sector, multiple challenges have to be addressed.

Keywords: artificial intelligence, AI, use, logistics, cost, supply chain

Introduction

Logistics has become an important industry in the global market, as the worldwide turnover produced by the logistics industry is more than 4.3 trillion US Dollars (World Bank, 2024). The logistics industry has been developing day by day to meet the needs of the global market, including better efficiency, accuracy, and speed. It increases the importance of implementing technologies in logistics. Researchers and logistics experts have been researching and implementing technologies including machine learning, robotic systems, the Internet of Things, and artificial intelligence (AI) to enhance logistics operations (Soori et al., 2023). Among these technologies, the article analyzes the use of artificial intelligence in logistics.

The system which uses artificial intelligence helps to carry out real-time tracking, predictive analytics, and robotic automation (Ferreira and Reis, 2023). Moreover, it helps to reduce human errors and operating expenses. Consequently, the article explores various aspects of using AI in logistics, including the mechanism of AI in reducing the cost of logistics operations.

Research aim: To find out the significance of artificial intelligence in logistics to improve supply chain management and reduce costs.

The following **objectives** have been set to achieve the aim:
1. To examine the advantages and disadvantages of using artificial intelligence in logistics.
2. To analyze the barriers to adopting artificial intelligence in logistics.
3. To identify the mechanism of artificial intelligence in reducing the cost of logistics operations.

Research object and methods

Research object: artificial intelligence in logistics

The research used a secondary research method. The data collection and analysis are carried out under the secondary research method. The data collection procedure began with the searching of data in Google Scholar, followed by filtering the search results with relevance and year. The data published between 2021 to 2024 is used in the research to analyze the use of artificial intelligence in logistics. Content analysis is used to analyze the collected secondary data.

Research results and discussion

Advantages and disadvantages of using artificial intelligence in logistics

The logistics sector has seen a transformation with the introduction of artificial intelligence, as per the Statista (2024) report the market revenue of AI is increasing globally (See Fig. 1). Moreover, it brought both significant advantages and disadvantages in industries like logistics. In the logistics industry, supply chain operations are optimised and productivity is increased by AI-powered technologies such as intelligent route planning, robotic automation, machine learning, and predictive analytics (Soori et al., 2023). However, there are disadvantages to using AI in logistics, including high implementation costs, worries about data security, and the possibility of job displacement (Maqbali et al., 2021). Businesses must be aware of AI's advantages and disadvantages to effectively cooperate with the operations.
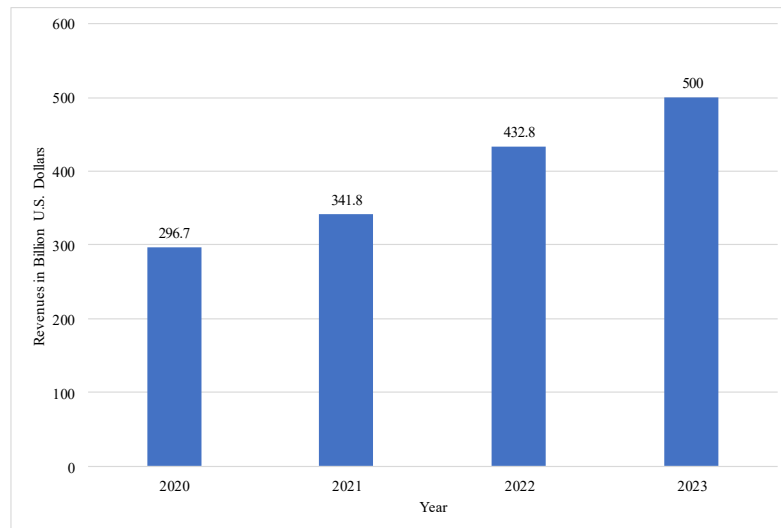
Fig. 1. Market revenue of artificial intelligence worldwide, 2020 to 2023, in Billion US Dollars

The potential of AI to improve accuracy and efficiency in logistics is a significant benefit. Large amounts of data are processed in real-time by AI-driven algorithms, which improve route planning, demand forecasting, and inventory management (Kaul and Khurana, 2022). Better decision-making, quicker delivery, and reduced operating expenses are the outcomes of this. Robotic picking and sorting systems and other automated warehouse solutions increase productivity by reducing human error and fastening order fulfilment. AI also makes predictive maintenance easier for fleets of vehicles, identifying possible mechanical problems before they cause delays or interruptions (Richey et al., 2023). Logistics firms may increase asset longevity and reduce downtime by using this proactive strategy. The ability of AI to lower costs in logistics is another important advantage. AI reduces fuel usage and operating costs by optimising transportation routes (Chen et al., 2024). Automation lowers labour costs by reducing the need for manual labour in warehouses and distribution centres. Chatbots and virtual assistants driven by AI improve customer service by handling enquiries effectively and relieving human agents of some of their effort (Rane et al., 2024). Additionally, companies may find inefficiencies and put plans in place to increase overall cost-effectiveness due to AI-driven supply chain data (Rane et al., 2024).

AI improves risk management and supply chain visibility. Logistics firms can keep an eye on shipments, spot any interruptions, and take preventative measures to reduce risks by using real-time tracking and data analytics (Richey et al., 2023). Businesses may reduce problems like supply shortages and excess inventory by using AI-powered demand forecasting to predict market trends and modify inventory levels accordingly. AI also improves security by protecting important logistical data by identifying fraudulent activity and cyber threats (Kaul and Khurana, 2022). Despite these advantages, there are several obstacles to overcome before AI can be widely used in logistics. The significant initial expenditure needed for execution is a significant disadvantage. It costs a lot of money to implement AI-driven technologies like machine learning algorithms and automated warehouses (Domingues, 2024). Small and medium-sized logistics firms may thus find it difficult to adopt these innovative solutions, which would affect their ability to compete with bigger competitors in the market.

The possible displacement of human workers is another significant concern. Roles that have historically been performed by humans, such as customer service and warehouse operations, may become less common as AI automates key logistical jobs (Rad et al., 2025). This change calls into question the morality of unemployment and emphasises the necessity of labour reskilling in order to adjust to the evolving business environment. Logistics firms are also in danger from cybersecurity issues due to AI's dependence on enormous volumes of data. AI-powered activities might be disrupted by threats including cyberattacks, data breaches, and system failures, which can lead to monetary losses and damage to one's reputation (Richey et al., 2023). Protecting AI systems and maintaining business continuity need the implementation of robust cybersecurity measures. While AI has many positive effects on logistics, such as increased productivity, cost savings, and better risk management, it also has drawbacks, including expensive implementation costs, the possibility of job losses, and security flaws in data (Richey et al., 2023). Businesses must carefully evaluate these aspects and put strategic solutions in place if they want to effectively use AI's benefits while reducing its issues.

**Barriers to adopting artificial intelligence in logistics**

By improving decision-making, reducing expenses, and increasing efficiency, the application of artificial intelligence in logistics has the potential to completely transform the sector. But even with all of its advantages, many logistics firms face major challenges when integrating AI into their operations. High implementation costs, data security threats, a lack of qualified personnel, change aversion, technological limitations, and legal concerns are some of these difficulties. For companies to fully benefit from AI and achieve sustainability in the logistics industry, these obstacles must be addressed. The high implementation costs are one of the main barriers to AI adoption in logistics. It costs a lot of money to implement AI-powered solutions like predictive analytics, automated warehouses, and intelligent

transportation systems (Rathore et al., 2022). The tools required for AI integration are frequently out of reach for small and medium-sized logistics companies. The costs of hiring staff, updating equipment, and buying AI-driven software might be huge and it can not be affordable. Furthermore, AI systems need constant upgrades, which raises long-term expenses even more. Many logistics companies struggle to engage in AI due to a lack of sufficient funding, which makes it more difficult for them to compete with larger organisations that can afford to adopt the latest technologies (Hangl et al., 2022).

Data security and privacy issues are major obstacles to the deployment of AI. AI-powered logistics systems rely on enormous volumes of data, including private client and corporate data. The increasing use of AI in supply chain management raises the possibility of data breaches, cyberattacks, and illegal access to private information. Logistics firms need to put robust cybersecurity safeguards in place to reduce these risks (Rathore et al., 2022). However, setting up sophisticated security procedures may be costly and difficult, which makes it a significant barrier to integrating AI. Additionally, worries about data exploitation and legal compliance make many companies hesitant to share their data with outside AI vendors (Kar et al., 2021). Another significant obstacle to the implementation of AI in logistics is the lack of qualified personnel. Proficiency in fields like automation, data analytics, and machine learning is necessary for AI technology (Hangl et al., 2022). However, the logistics sector has historically relied on manual labour and traditional management techniques, which has led to a shortage of experts in AI-driven solutions. Companies must fund training and reskilling initiatives to close this skill gap and provide staff members with the know-how to operate AI technology (Kar et al., 2021). Hiring and keeping AI experts is still difficult, though, especially for small organisations that do not have the funding to compete for top talent. Another significant barrier to the use of AI in logistics organisations is resistance to change. Because of worries about AI's efficacy and the possibility of job displacement, many companies are reluctant to transition from conventional logistical techniques to AI-driven operations (Kar et al., 2021).

**Mechanism of artificial intelligence in reducing the cost of logistics operations**

Implementing artificial intelligence in logistics helps companies to reduce the cost. It also helps to increase the operational efficiency. By analyzing the literature, it is found that many companies achieved the benefit of cost reduction by the implementation of artificial intelligence in their logistics operations. AI improves inventory management, shipping, warehousing, and customer service, among other logistical operations, by using automation, predictive analytics, machine learning, computer vision, natural language processing and real-time data processing (Chen et al., 2024). Using AI-powered solutions may help logistics companies increase supply chain performance, reduce costs, and smooth operations. Recent reports on global AI in the logistics market, as mentioned in Fig. 2., highlighted that the market size of AI in logistics was 12 US dollars in 2023 and it will be 549 US dollars in 2033, hence, the market will witness growth of CAGR 46.7 per cent (Market.us, 2024).
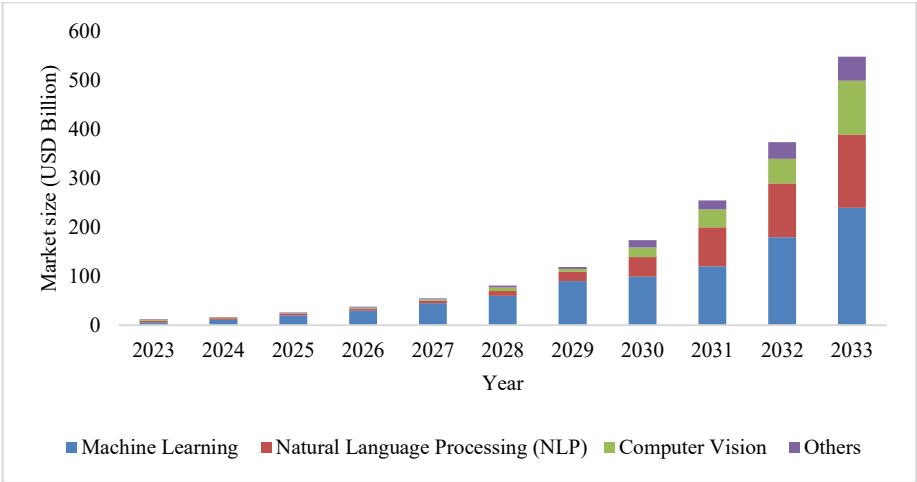
Source: According to Market.us, 2024

Fig. 2. Market size of AI in logistics worldwide

Demand forecasting and predictive analytics are two of AI's most important cost-saving uses in logistics. Businesses may improve inventory management by using AI-powered algorithms that evaluate huge amounts of historical and real-time data to forecast changes in demand (Domingues, 2024). Businesses may reduce storage expenses and minimise financial losses from unsold goods or stock shortages by avoiding overstocking and understocking with the aid of accurate demand forecasts (Domingues, 2024). Amazon improved their logistics using AI-driven technologies, as mentioned in Fig. 3. For example, the company utilises AI-driven forecasting algorithms to predict client demand to ensure that warehouses maintain ideal stock levels. This strategy maximises profits while lowering the expenses associated with surplus inventory.
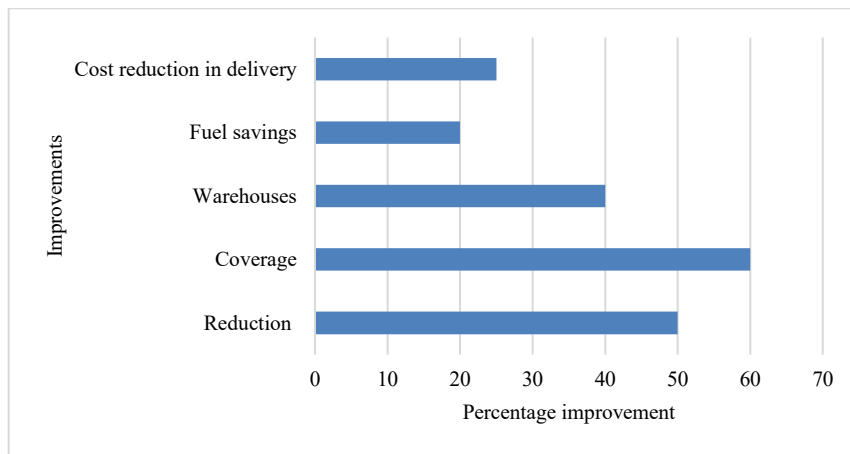
Fig. 3. AI-driven improvements in Amazon Logistics in 2024

AI-driven route optimisation for delivery and transportation management is another important logistics cost-reducing strategy. AI determines the most effective delivery routes by examining real-time traffic patterns, weather, fuel efficiency indicators, and traffic congestion (Soori et al., 2023). Logistics businesses may reduce delivery times, vehicle issues, and fuel use with this optimisation. To find the quickest and most fuel-efficient delivery routes, businesses like UPS use AI-based routing solutions like ORION (On-Road Integrated Optimisation and Navigation). UPS saves millions of miles a year due to ORION, which significantly lowers fuel expenses. Logistics companies may reduce shipping costs and improve sustainability by implementing AI-powered route optimisation (Lysenko, Makovoz and Perederii, 2023). As technologies improve operational efficiency and accelerate logistical procedures, warehouse automation and smart warehousing are important for cost reduction. Robotic systems with AI capabilities are more accurate and faster than human workers at picking, packing, sorting, and inventory management (Kar et al., 2021). Robotic arms and automated guided vehicles (AGVs) reduce the need for manual labour, which lowers labour costs and the possibility of human mistakes. Prominent corporations such as Alibaba and Walmart incorporate artificial intelligence-powered robotic devices into their fulfilment centres to effectively handle high order volumes. For instance, Alibaba's smart warehouse in China uses AGVs and robotic arms to move packages on their own, greatly reducing processing times and increasing efficiency. Significant cost reductions in warehouse operations are a result of this high degree of automation (Minh, 2024).

By managing risks and detecting fraud, AI also helps to lower shipping costs. In order to spot irregularities that can indicate fraudulent activity, including cargo theft or illegal access to logistics systems, AI algorithms examine transaction patterns (Rad et al., 2025). Businesses may reduce fraud-related financial losses and improve supply chain security by utilising AI-driven security solutions. By putting AI-based fraud detection technologies into place, logistics companies may proactively stop losses, increasing operational effectiveness and reducing unnecessary expenditures (Kar et al., 2021).

By simplifying client interactions, AI-powered customer service automation significantly lowers costs. Without the need for human interaction, AI chatbots and virtual assistants effectively respond to consumer questions, offer real-time shipment tracking updates, and handle return requests (Hangl et al., 2022). Because of this automation, customer care agents have less work to do, which enables companies to cut labour expenses without sacrificing customer pleasure. AI-driven customer support solutions are used by FedEx and DHL to handle basic enquiries, freeing up human staff to concentrate on more complicated problems (Tyagi et al., 2024; P et al., 2024). Logistics companies may save workforce costs while guaranteeing quicker and more accurate replies by deploying AI chatbots, which will eventually increase service efficiency.

AI also improves cost reduction through sustainability and energy efficiency projects. Energy management systems and smart sensors driven by AI optimise power use in warehouses, resulting in reduced electricity expenses. AI can identify trends in energy use and recommend changes to reduce waste, which makes logistical operations more economical and ecologically friendly (Kar et al., 2021). Even though AI has a lot to offer in terms of cost savings, integrating it into logistics necessitates huge initial infrastructure and technology expenditures. Nevertheless, these initial expenditures are frequently justified by the long-term advantages, which include increased productivity and lower costs. Supply chain operations may become more robust, flexible, and cost-effective as AI-driven logistics solutions develop. By lowering expenses, increasing operational effectiveness, and raising customer satisfaction, companies that successfully implement AI can obtain a competitive advantage (Domingues, 2024). Moreover, it helps bothy both customers and enterprises. AI-powered customer service decreases operating costs, warehouse automation increases productivity, fraud detection improves security, and predictive analytics better inventory management. Companies like Alibaba, Tesla, UPS, and Amazon are prime examples of how AI can save costs. AI technology will have a greater impact on cost-effectiveness as it develops further, assisting companies in remaining competitive.

Conclusions

1. The article found that implementing AI has both advantages and disadvantages. AI has significantly increased logistics' accuracy, efficiency, and cost-effectiveness by utilising automation, supply chain optimisation, and predictive analytics. AI-powered solutions improve demand forecasting, risk mitigation, and route optimisation, which eventually reduces operating costs. However issues including high implementation costs, job displacement, and cybersecurity concerns still present difficulties. Businesses must prioritise strategic investments in cybersecurity, training for employees, and cost-effective use techniques if they want to fully benefit from AI.

2. Although AI has the potential to transform logistics, adoption has been challenged by a number of factors. Significant investment demands, data security concerns, a lack of qualified personnel, and change resistance are some of the main obstacles. Financial limitations are a problem for small and medium-sized businesses in particular, and implementation is further slowed by privacy and legal issues. Study's findings highlighted that investments in cybersecurity, staff development, and staged AI integration plans are required to address these issues.

3. Additionally, by using automation and predictive analytics to optimise inventory control, shipping, and customer service, AI significantly lowers logistical costs. It will be expected that growing AI use would promote market expansion by improving intelligent decision-making and real-time tracking. Businesses must implement AI-driven innovations while ensuring their adoption plans are sustainable if they want to remain competitive. AI's long-term effects on the logistics sector will depend on the way these issues are resolved.

References

1. Chen, W., Men, Y., Fuster, N., Osorio, C., & Juan, A. A. (2024). Artificial Intelligence in Logistics Optimization with Sustainable Criteria: A Review. *Sustainability*, 16(21), 9145. https://doi.org/10.3390/su16219145

2. Domingues, L. (2024, July 25). *Artificial Intelligence driving intelligent logistics: Benefits, challenges, and drawbacks*. Retrieved March 9, 2025, from http://hdl.handle.net/10071/32359

3. Ferreira, B., & Reis, J. (2023). A Systematic Literature Review on the Application of Automation in Logistics. *Logistics*, *7*(4), 80. https://doi.org/10.3390/logistics7040080

4. Hangl, J., Behrens, V. J., & Krause, S. (2022). Barriers, Drivers, and Social Considerations for AI adoption in Supply Chain Management: a Tertiary study. *Logistics*, 6(3), 63. https://doi.org/10.3390/logistics6030063

5. Kar, S., Kar, A. K., & Gupta, M. P. (2021). Modeling Drivers and Barriers of Artificial Intelligence Adoption: Insights from a Strategic Management Perspective. *Intelligent Systems in Accounting Finance & Management*, 28(4), 217–238. https://doi.org/10.1002/isaf.1503

6. Kaul, D., & Khurana, R. (2022). Ai-driven optimization models for e-commerce supply chain operations: Demand prediction, inventory management, and delivery time reduction with cost efficiency considerations. *International Journal of Social Analytics*, 7(12), 59-77.

7. Lysenko, S., Makovoz, O., & Perederii, T. (2023, June). The impact of artificial intelligence in logistics management on sustainability development of e-business. In *European dimensions of the sustainable development and Academic–Business Forum: Let's revive Ukraine together*.

8. Maqbali, K. H. A., Slimi, Z., & Balasa, A. (2021). The Pros and Cons of Artificial Intelligence use in the Logistics Sector in Oman. *European Journal of Business Management and Research*, 6(4), 197–208. https://doi.org/10.24018/ejbmr.2021.6.4.973

9. Market.us. (2024, March 19). *AI in Logistics Market Size, Top Share | CAGR of 46.7%*. Retrieved March 9, 2025, from https://market.us/report/ai-in-logistics-market/

10. Minh, V. (2024). Technology in Warehouse Management. *Transforming Logistics in a Developing Nation: Vietnam's Technology Imperative*, 297.

11. P, S., Shetty, P. P., E, S. B., & M, P. H. (2024). Predictive Analytics and AI in Logistics: Driving Operational Excellence and Cost Reduction. *IEEE*, 1–6. https://doi.org/10.1109/csitss64042.2024.10817044

12. Preprint. (2024). *Artificial Intelligence and Logistics: Recent Trends and Development*. Retrieved March 9, 2025, from https://www.preprints.org/manuscript/202410.2141/v1

13. Rad, F. F., Oghazi, P., Onur, İ., & Kordestani, A. (2025). Adoption of AI-based order picking in warehouse: benefits, challenges, and critical success factors. *Review of Managerial Science*. https://doi.org/10.1007/s11846-025-00858-1

14. Rane, N., Choudhary, S., & Rane, J. (2024). Artificial Intelligence (AI), Internet of Things (IoT), and blockchain-powered chatbots for improved customer satisfaction, experience, and loyalty. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4847274

15. Rathore, B., Gupta, R., Biswas, B., Srivastava, A., & Gupta, S. (2022). Identification and analysis of adoption barriers of disruptive technologies in the logistics industry. *The International Journal of Logistics Management*, *33*(5), 136–169. https://doi.org/10.1108/ijlm-07-2021-0352

16. Richey, R. G., Chowdhury, S., Davis-Sramek, B., Giannakis, M., & Dwivedi, Y. K. (2023). Artificial intelligence in logistics and supply chain management: A primer and roadmap for research. *Journal of Business Logistics*, *44*(4), 532–549. https://doi.org/10.1111/jbl.12364

17. Soori, M., Arezoo, B., & Dastres, R. (2023). Artificial intelligence, machine learning and deep learning in advanced robotics, a review. *Cognitive Robotics*, 3, 54–70. https://doi.org/10.1016/j.cogr.2023.04.001

18. Statista. (2024, February 16). *Global artificial intelligence market revenues 2023 | Statista*. Retrieved March 9, 2025, from https://www.statista.com/statistics/694638/worldwide-cognitive-and-artificial-intelligence-revenues/

19. Tyagi, L., Gupta, A., & Sisodia, V. S. (2024). Revolutionizing Industries: AI-Driven Case Studies and Success Stories in Real-World Applications and Innovations. *IEEE*, 1–9. https://doi.org/10.1109/icscai61790.2024.10866349

20. World Bank. (2024). *Connectivity, logistics & trade facilitation*. World Bank. Retrieved March 8, 2025, from https://www.worldbank.org/en/topic/trade-facilitation-and-logistics