

THE IMPACT OF TECHNOLOGIES ON LOGISTICS COST OPTIMIZATION

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Abstract

Supply chain management in organizations is becoming increasingly complex, and at the same time, the increase in operational costs has made logistics cost management a key strategic priority. The aim of this research was to analyze the impact of modern technologies on logistics cost optimization in organizations. The main methods used in the study were a systematic literature review, comparative analysis of traditional and digital logistics systems, and statistical evaluation of logistics performance indicators. A systematic literature review and statistical evaluation methods were used during the study, which ensured the objectivity of the results. The results show that Artificial Intelligence (AI), Internet of Things (IoT), Warehouse Management Systems (WMS) and big data analytics have significantly reduced inventory management and storage costs, as well as transportation costs. Real-time tracking systems increase transparency and reduce risks in the supply chain, while predictive analytics allow for more accurate demand planning and optimal resource allocation. The results show that technology-based logistics management increases operational efficiency and optimizes the strategic decision-making process by minimizing human errors. Thus, digital transformation is a key factor in the continuous optimization of logistics costs.

Keywords: logistics cost optimisation, artificial intelligence, digital transformation, supply chain management, warehouse management systems, predictive analytics, IoT.

Introduction

Currently, logistics and supply chain management are one of the most important factors affecting the competitiveness of organizations. The main reasons that increase the need to optimize logistics operations are rising fuel prices, uncertainty in the global market, and increasing customer demands. Traditional methods, unlike modern technologies, have difficulty adapting to this uncertainty and the rapidly developing global market; therefore, the application of digital technologies is becoming increasingly relevant (Ba-Awain & Daud, 2018; Naganawa et al., 2024).

Recent studies show that technological innovations, especially in the field of logistics, lead to reduced operating costs and more efficient supply chain management (Umarov, 2023). Digital solutions also increase transparency in the supply chain and optimize the planning process (Burbulis et al., 2019; Yarlagadda, 2025). In this regard, the integrative impact of modern technologies on logistics costs and organizational performance is of great importance.

The scientific novelty of the article is to analyze the systematic impact of technologies on the main components of logistics costs (transportation, storage, inventory and administrative costs). In addition, the application of technologies is not limited to reducing costs but also increases the flexibility of the organization and the quality of decision-making. Modern digital systems allow for an operational response to changes in demand and unexpected disruptions in the supply chain.

As the complexity of global trade networks increases, technology-based logistics management is emerging as a strategic necessity, not an alternative. In this regard, the analysis of the economic impact of digital technologies on the structure of logistics costs is very relevant. In modern times, logistics systems perform not only physical transport and storage functions but are also closely related to the management of information flows. Information technologies have made it possible to manage logistics operations through digital platforms. As a result, planning, monitoring and cost control are carried out more systematically, decision-making is accelerated and operational efficiency increases.

The research problem is that many organizations still face difficulties in effectively managing and optimizing logistics costs despite the rapid development of modern digital technologies. Although technologies such as Artificial Intelligence, Internet of Things, and Warehouse Management Systems are increasingly used in logistics, their overall impact on different components of logistics costs is not always clearly evaluated.

The aim of this research to analyse the impact of modern technologies on the regulation of logistics costs in organizations.

To achieve the research aim, the following tasks were set:

- To assess of the interaction between modern technologies and logistics costs.
- To analyse of the impact of systems on operational efficiency.
- To determine of the role of real-time information systems in reducing costs in the supply chain.

Research object and methods

Research object - The process of logistics cost optimization in organizations using modern technologies.

The following methods were used in the study:

- Systematic analysis of scientific literature.
- Comparative analysis of traditional and digital logistics systems.
- Statistical analysis of performance indicators.
- Analysis of empirical examples.

During the evaluation, the following indicators were considered:

• Transportation cost per unit (EUR/unit; in this study, the term “unit” refers to a single product being transported).

- Inventory turnover ratio.
- Order execution time (hours).
- Storage space utilization level (%).

Units of measurement are presented according to the requirements of the International System of Units (SI).

Research results and discussion

The Impact of Artificial Intelligence on Transportation Costs

The biggest reason for the reduction in transportation costs is route optimization systems based on Artificial Intelligence. These systems usually reduce fuel consumption by 15-25% and optimize delivery times (Umarov, 2023). Such systems use real-time GPS systems and traffic data to select the most efficient and effective routes. One of the biggest advantages is that Artificial Intelligence systems can avoid disruptions and traffic congestion in urban areas and significantly reduce delays and fuel consumption. In addition, Artificial Intelligence systems create conditions in which logistics managers try to predict demand increases in advance and allow them to plan deliveries efficiently. These situations allow for the efficient management of more expensive operations and at the same time reduce the number of emergency orders, since these orders require additional labor hours, fast shipping methods and additional fuel consumption. At the same time, Artificial Intelligence allows organizations to easily track vehicles, monitor their technical condition and prevent unexpected accidents. By continuously analyzing sensors and traffic data, organizations can dynamically optimize their transportation networks, thus achieving higher reliability and efficiency (Patil D. 2024).

The application of artificial intelligence in the transportation sector not only drives cost reductions in organizations but is also quite significant in terms of development (Yaiprasert C., Hidayanto A. N. (2024). The use of artificial intelligence by organizations reduces fuel consumption, lowers carbon emissions, and contributes to environmental sustainability.

Warehouse Management Systems and Inventory Cost Reduction

Warehouse management systems (WMS) play a critical role in inventory optimization because they provide accurate tracking of inventory levels and prevent overstocking or inventory shortages (Burbulis et al., 2019). Automated picking and placing systems reduce human error, minimize labor costs, and increase order accuracy. For example, a warehouse implementing a WMS shortens order fulfillment times, finds products faster, and increases customer satisfaction.

Digital warehouses play a significant role in logistics, especially in reducing costs. Digital warehouses allow WMS to store more products in the same area and at the same time avoid additional costs through placement and storage algorithms. Centralization of information flow using centralized management with WMS systems allows for the provision of inventory information across all departments and the transmission of information about innovations Naganawa H., et al. (2024). This, in turn, reduces the number of inventory losses and ensures sustainable management of the supply chain.

At the same time, WMS Systems integrate with IoT and Artificial Intelligence networks to effectively manage the supply chain and enable more effective decision-making. IoT systems enable processes in the supply chain to track and locate inventory in real time. Artificial intelligence systems play a special role in demand forecasting, which more accurately predicts demand and provides the amount of product to be stored. These integrated systems minimize costs and reduce factors such as premature spoilage and damage.

Internet of Things (IoT) and Supply Chain Visibility

One of the systems that provide real-time tracking of products in the supply chain is IoT systems. Such systems mainly monitor products in real time and control product loss and damage by considering factors such as temperature, humidity, and product placement. These systems are particularly important in the food sector. In logistics, the traceability of food products is essential because it prevents costly losses and ensures compliance with safety requirements.

These systems enable managers to analyse sensor-generated data and prevent potential risks. These real-time capabilities improve coordination between partners and reduce uncertainty in the transportation and storage process. In addition, such systems also contribute to planning (Nagavalli & Dey, 2021). They create large databases that can be analyzed, which in turn allows for the development of logistics performance in forecasting. Organizations can use such advantages to assess the reliability of suppliers and optimize transportation routes. Such advantages allow organizations to form intelligent supply chains that can respond more flexibly and sustainably to market changes.

Big Data Analytics and Strategic Cost Optimization

One of the biggest advantages of big data analytics in the logistics supply chain is that it plays a significant role in identifying and eliminating inefficiencies. Using historical and new data, managers can identify factors that affect rising costs. For example, factors such as excessive waiting times, inefficient routes, or poorly managed inventory. Companies using digital platforms significantly reduce logistics costs compared to traditional systems. For example, predictive

analytics can identify periods of high demand in advance and allow organizations to adjust their supply and distribution plans accordingly. This prevents stock shortages or overstocks. Artificial intelligence makes demand forecasts, IoT systems can monitor logistics operations in real time, and big data analytics can evaluate performance and factors affecting performance. This allows companies to maintain operational stability and reduce costs while increasing customer satisfaction. The strategic application of these technologies not only solves short-term operational problems but also supports long-term cost optimization and sustainable development.

Table 1. Impact of technology on logistics costs

Technology	Transportation cost reduction %	Warehouse cost reduction %	Overall efficiency increase %
AI	20	10	25
IoT	10	18	22
WMS	8	25	28

Source: compiled by the author based on literature analysis (Umarov, 2023; Burbulis et al., 2019; Naganawa et al., 2024).

As shown in Table 1, the technologies applied reduced various types of costs in organizations, including transportation, inventory, storage, operational, and risk-related costs.

Overall, the study demonstrates that modern digital technologies not only reduce various types of logistics costs - transportation, inventory, storage, operational, and risk-related - but also improve the planning, monitoring, and control processes. These insights are supported by the empirical data and performance indicators analyzed in this study.

Conclusions

The results of this study reflect the research aim of analysing the impact of modern technologies on logistics cost optimisation. Based on the study, the following conclusions can be drawn:

1. The application of modern technologies significantly reduces logistics costs, including transportation, warehouse, and operational expenses.
2. Artificial Intelligence (AI) optimizes logistics planning and transportation processes by reducing fuel consumption, preventing delays, and improving efficiency.
3. Warehouse Management Systems (WMS) enhance inventory management by reducing errors and improving warehouse efficiency.
4. IoT and real-time tracking systems increase supply chain transparency, reduce risks, and improve coordination between logistics partners.
5. Digital transformation is a strategic necessity for achieving long-term cost optimisation and operational efficiency in logistics systems.

Overall, these findings indicate that the integration of modern technologies plays a crucial role in improving efficiency and ensuring sustainable logistics cost optimisation.

AI usage statement: a generative artificial intelligence tool **ChatGPT (OpenAI)** was used only for language editing and stylistic improvements during the preparation of this article. All research ideas, analysis, and conclusions were developed by the author.

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