IBIMA Publishing
Communications of International Proceedings
https://ibimapublishing.com/p-articles/46MGT/2025/4635325/
Vol. 2025 (30), Article ID 4635325

The Impact of Implementing Automation Systems on Operational Efficiency in the Logistics Sector*

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* Presented at the 46th IBIMA International Conference, 26-27 November 2025, Ronda, Spain

Abstract

The growing complexity of global supply chains and the rapid development of e-commerce have made automation a strategic necessity for logistics companies seeking to improve operational efficiency. This paper analyzes the impact of automation technologies including Warehouse Management Systems (WMS), Automated Guided Vehicles (AGVs), and AutoStore systems on the performance of logistics operations. The study identifies the main benefits of automation, such as shorter order fulfillment times, lower operational costs, and higher process accuracy. Data drawn from industry reports and case studies demonstrate that automation can reduce order fulfillment times by up to 30%, operational costs by 25–30%, and order errors by 40–50%. Moreover, automation supports sustainable development goals by reducing energy consumption and CO_2 emissions. However, the research also highlights key challenges, including high investment costs, infrastructure adaptation needs, and shortages of qualified personnel. The analysis confirms that automation significantly enhances logistics performance and competitiveness while requiring enterprises to adopt a holistic approach that integrates technology implementation with employee training and sustainable business strategies.

Keywords: automation, logistics, operational efficiency, Warehouse Management Systems, AGV Robots, robotics

Introduction

With the dynamic growth of e-commerce and the globalization of supply chains, logistics companies are increasingly compelled to seek new methods for optimizing their operations. The use of advanced technologies such as robotics, artificial intelligence (AI), the Internet of Things (IoT), and Warehouse Management Systems (WMS) enables them to streamline processes and adapt to evolving market demands.

In industries such as manufacturing, retail and logistics, automation brings significant benefits, including reduced operational costs, shorter order fulfillment times, and minimized errors. As an integral component of global supply chains, the logistics sector plays a crucial role in ensuring the smooth flow of goods between manufacturers, distributors, and end customers. With rising expectations for fast and precise order fulfillment, logistics enterprises are increasingly investing in modern technologies. It is automation, encompassing mobile robots, sorting systems,

Cite this Article as: Zuzanna BORDA, Vol. 2025 (30) "The Impact of Implementing Automation Systems on Operational Efficiency in the Logistics Sector " Communications of International Proceedings, Vol. 2025 (30), Article ID 4635325, https://doi.org/10.5171/2025.4635325

and advanced inventory management software, that allows for improved operational performance and better utilization of resources (IFR International Federation of Robotics, 2024).

The dynamics of the logistics automation market are confirmed by data presented in the World Robotics 2024 report. The number of operational industrial robots worldwide has surpassed 4.28 million, a significant portion of which is used in warehouses and distribution centers across the globe (Müller et al., 2024).

In the context of logistics, automation delivers numerous advantages, such as shorter order fulfillment times, reduced operational costs, and increased process accuracy. Systems like AutoStore optimize inventory management by enhancing warehouse space utilization and reducing travel distances for robots (Kempe Kevin et al., 2024). Moreover, autonomous vehicles (AGVs) eliminate the need for manual goods transport, leading to greater safety and improved efficiency (Zientek et al., 2018).

At the same time, the implementation of automation presents several challenges. High initial investment costs, the need to adapt warehouse infrastructure, and employee resistance to new technologies constitute significant barriers, particularly for smaller enterprises (McKinsey & Company, 2018).

In the Polish context, where the automation market is still developing, an additional challenge is the shortage of sufficiently qualified personnel capable of operating automated logistics systems (McKinsey & Company, 2018).

Automation also plays an important role in achieving sustainable development goals, which has become a priority for many enterprises operating within the European Union. Energy-efficient systems, the integration of renewable energy sources, and the reduction of CO_2 emissions are among the measures undertaken by companies to reduce their carbon footprint. These technologies not only contribute to the optimization of logistics processes but also help build a positive corporate image of businesses as socially and environmentally responsible organizations (Kempe Kevin et al., 2024).

The aim of this article is to analyze the impact of automation on operational efficiency in the logistics sector. The paper identifies key benefits and challenges associated with the implementation of automated systems.

The potential of automation in logistics

The potential for automation in logistics is becoming increasingly evident in light of global economic trends and growing market demands. Industry reports indicate that approximately 49% of tasks performed in the Polish logistics sector could be automated through the use of existing technologies such as Warehouse Management Systems (WMS), sorting robots, and autonomous vehicles (McKinsey & Company, 2018).

Among European countries, Poland stands out with a significant level of automation potential, comparable to the global average. In industries such as warehousing, transportation, and manufacturing, automation could account for as much as 64–65% of total working time, making these sectors the most susceptible to the adoption of new technologies (McKinsey & Company, 2018).

The implementation of automation in logistics not only enables process optimization but also contributes to increased productivity and reduced operational costs. For example, WMS systems allow for more efficient inventory management, reducing the number of errors and improving customer service quality. Additionally, technologies such as AutoStore and AGV robots enhance warehouse space utilization and shorten order fulfillment times (Kempe Kevin et al., 2024).

Automation also plays a key role in helping enterprises adapt to challenges related to the shortage of skilled labor and rising employment costs. According to the World Robotics 2024 report, the global market for industrial robots grew by 10% in Europe in 2023, indicating increased interest in automation investments within the logistics sector (IFR International Federation of Robotics, 2024).

The future of logistics is inseparably linked to the continued development of automation. Technological progress, including advances in AI and IoT, opens new opportunities for enterprises seeking to increase operational efficiency and meet the goals of sustainable development. Automation not only enables cost optimization but also enhances process flexibility, which is crucial in today’s dynamically changing business environment.

Operational efficiency in logistics through automation

Automation in logistics is revolutionizing the management of warehouse and transportation operations. Process optimization enables companies to reduce costs, increase precision, and significantly shorten order fulfillment times, resulting in improved customer satisfaction and enhanced competitiveness.

Reducing order fulfillment time is one of the primary advantages of automation. According to the Extensiv report 7 Third-Party Logistics Warehouse Statistics You Should Know, automated warehouse systems such as AutoStore can shorten order picking time by 20–30% through precise product localization and the minimization of unnecessary movements within the warehouse (Extensiv, 2024.; Wyraz, 2015). The use of automated conveyors and mobile robots (AGVs) further reduces internal transport time, accelerating warehouse operations by up to 25% (Zientek *et al.*, 2018; Kempe Kevin *et al.*, 2024).

Warehouse Management Systems (WMS) also contribute to improved planning and organization of operations, reducing order fulfillment time by an additional 15–20%. Müller (2024) notes that the implementation of WMS in large logistics centers has increased operational throughput, enabling faster order processing while maintaining high accuracy levels (Müller, p. 14) .

Automation also enables significant reductions in operational costs by lowering the demand for human labor and minimizing errors in logistics processes. Wyraz (2024) reports that the implementation of AutoStore technology reduced operational costs by 20–30%, primarily due to more efficient warehouse space management and the reduced number of employees required for warehouse operations (Wyraz, 2015; Kempe Kevin et al., 2024).

Cost savings also result from the use of energy-efficient technologies. Automated systems consume up to 85% less energy compared to traditional warehouse operations, generating substantial financial savings, particularly in the context of rising energy prices (Kempe Kevin et al., 2024; Müller et al., 2024)

Moreover, automation reduces costs associated with errors and customer complaints. Zientek (2024) reports that automated systems lowered the number of errors by 40–50%, which led to a 10% reduction in expenses related to complaints and returns (Zientek et al., 2018).

The accuracy of logistics operations and processes increases significantly through the use of automation technologies such as IoT and RFID systems, which enable real-time tracking of goods. Kempe (2024) indicates that the implementation of automated sorting and picking systems reduced order fulfillment errors by 50%. Wyraz (2024) highlights the improvement in order accuracy, leading to a 35% reduction in product returns and higher customer satisfaction. The use of advanced algorithms in WMS also enables precise demand forecasting, minimizing the risk of overstocking and stockouts (Müller et al., 2024).

Examples of automation implementation in Polish and international enterprises demonstrate measurable benefits. In the Polish company X, the adoption of a WMS system increased operational efficiency by 18% and improved the OTIF (On Time In Full) performance indicator to 98% (Zientek et al., 2018) . In contrast, the German company Y achieved a 25% reduction in operational costs and a 35% improvement in order accuracy after implementing AGV robots (Kempe Kevin et al., 2024).

Furthermore, sustainable development is becoming an increasingly important element of automation strategies in logistics. Technologies such as AutoStore enable a 25–30% reduction in CO_2 emissions, which is crucial given tightening environmental regulations Companies implementing energy-efficient solutions not only lower operational costs but also strengthen their reputation as socially responsible organizations (Wyraz, 2015).

Discussion

The analysis of the literature indicates that automation plays a crucial role in improving operational efficiency in logistics. The implementation of AutoStore systems, AGV robots, and Warehouse Management Systems (WMS) significantly shortens order fulfillment times, reduces operational costs, and minimizes the number of errors. Wyraz (2015 notes that automation can reduce operational errors by as much as 40–50%, leading to higher customer satisfaction and lower return-related costs.

Similar conclusions are drawn by Müller (2024), who highlights the acceleration of warehouse processes through robotization. In e-commerce warehouses, the use of automated systems has increased throughput by 30%, which has greatly enhanced the ability of companies to respond quickly to changing market demands (Extensiv, 2024). Zientek (2024) also emphasizes that the implementation of mobile robots has reduced internal transport time by 25%, further improving warehouse efficiency.

The McKinsey (2018) report emphasizes that approximately 49% of tasks performed in logistics in Poland could be automated, revealing a tremendous potential for improving operational processes. The IFR (2024) report shows that the number of industrial robots increased globally by 10% in 2023, confirming the dynamic growth of automation in logistics.

Kempe (2024) and Michalski (2021) highlight the key role of IoT and RFID technologies in real-time monitoring of logistics processes, enabling the elimination of errors and more effective inventory management. Granlund and Wiktorsson (2014) point out that precise demand forecasting using automated systems allows companies to minimize the risk of overstocking or stock shortages.

Challenges and perspectives

Despite its numerous benefits, automation is associated with several significant challenges. One of the main obstacles is the high cost of implementing advanced technologies. Investments in systems such as AutoStore can range from several hundred thousand to several million Polish zlotys, which poses a substantial barrier for small and medium-sized enterprises.

A shortage of qualified personnel and the need to adapt existing logistics infrastructure to accommodate new technologies generate additional costs and extend the implementation process. Furthermore, successful automation requires not only financial investment in technology but also in employee training and skill development.

Nevertheless, the prospects for the development of automation in logistics are highly promising. The potential integration of systems with AI and IoT technologies will enable full real-time process optimization, significantly enhancing operational flexibility. Sustainable development represents another key direction of progress. Technologies such as AutoStore contribute to a 25% reduction in CO_2 emissions, aligning with the climate goals pursued by many enterprises.

From a research perspective, it is also important to note that detailed data directly provided by enterprises remain limited. As a result, researchers face the challenging task of accurately and comprehensively assessing the true impact of automation on the logistics industry.

ConclusionsIn summary, automation in logistics significantly contributes to improving operational efficiency by shortening order fulfillment times, reducing operational costs, and increasing process accuracy. The collected data confirm that the implementation of advanced systems such as AutoStore, WMS, and AGV robots enhances key performance indicators such as OTIF and reduces the number of product returns.

It is recommended that enterprises prioritize the implementation of automation in warehousing and internal transport operations while simultaneously investing in employee skill development. A key component of automation strategy should also involve collaboration with research institutions to develop best practices and monitor the long-term impact of automation technologies on logistics operations.

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