ORIGINAL PAPER

# APPLICATION OF ARTIFICIAL INTELLIGENCE IN LOGISTICS PROCESSES – A CASE STUDY OF MICHELIN POLAND LTD.

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A b s t r a c t

This article focuses on analyzing the use of artificial intelligence (AI) in logistics processes using the example of Michelin Poland Ltd. The purpose of the paper is to assess the degree of application of AI technology in logistics and its impact on operational efficiency. The research includes a literature analysis, a survey of Michelin employees and an evaluation of the effectiveness of the implemented solutions. The results indicate that the implementation of AI has contributed to improving process efficiency, increasing the quality of work and reducing operating costs. Challenges to AI adaptation were also identified, such as high implementation costs and potential employee layoffs. The analysis confirmed that AI is a key component of logistics management strategies in the context of Industry 4.0, contributing to the company's competitiveness. The article underscores the importance of sustainably implementing AI technologies to maximize benefits and minimize risks, offering valuable lessons for logistics managers and researchers.

**ZASTOSOWANIE SZTUCZNEJ INTELIGENCJI W PROCESACH LOGISTYCZNYCH – STUDIUM PRZYPADKU MICHELIN POLSKA SP. Z O.O.**

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A b s t r a k t

W artykule skupiono się na analizie wykorzystania sztucznej inteligencji (AI) w procesach logistycznych na przykładzie przedsiębiorstwa Michelin Polska Sp. z o.o. Celem pracy jest ocena stopnia zastosowania technologii AI w logistyce oraz jej wpływu na efektywność operacyjną. Badania obejmują analizę literatury przedmiotu, badania ankietowe wśród pracowników Michelin oraz ocenę skuteczności wdrożonych rozwiązań. Wyniki wskazują, że wdrożenie AI przyczyniło się do poprawy efektywności procesów, zwiększenia jakości pracy oraz redukcji kosztów operacyjnych. Zidentyfikowano także takie wyzwania związane z adaptacją AI, jak wysokie koszty wdrożenia oraz potencjalne zwolnienia pracowników. Analiza pozyskanych danych potwierdziła, że AI stanowi główny element strategii zarządzania logistyką w kontekście Przemysłu 4.0, przyczyniając się do wzrostu konkurencyjności przedsiębiorstwa. W artykule podkreślono znaczenie zrównoważonego wdrażania technologii AI w celu maksymalizacji korzyści i minimalizacji ryzyk, zaoferowano cenne wskazówki dla menedżerów logistyki oraz badaczy.

# Introduction

Logistics constitutes a key element of business operations, particularly in the context of supply chain management. The literature emphasizes that logistics encompasses a wide range of activities, including planning, implementing, and controlling the flow of goods and information. The primary goal of these processes is to meet customer expectations efficiently and sustainably (Setthachotsombut *et al.*, 2024, p. 1, 2; Aslam *et al.*, 2024, p. 1, 2). Modern enterprises utilize logistics not only as a tool for optimizing operational activities but also as a significant source of competitive advantage. Increasing attention is being devoted to integrating logistics with advanced technologies, which enable better coordination of activities and the reduction of operational costs (Wang *et al.*, 2024, p. 1-3).

In the era of dynamic development in information technology, data and information play a crucial role in supporting decision-making in logistics. As noted by Qin & Wan (2024, p. 84-86), precise collection, analysis, and distribution of information form the foundation of effective supply chain management. Artificial intelligence technologies offer new opportunities in this area, enabling more accurate demand forecasting, more efficient inventory management, and distribution process optimization. Consequently, businesses can make better-informed decisions while simultaneously reducing operational risk (Kaup *et al.*, 2024, p. 5506, 5507).

Logistics efficiency, as one of the key indicators of operational performance, plays a significant role in assessing the effectiveness of enterprise management. Measurement tools, such as stimulant, destimulant, and nominative indicators, allow for precise monitoring of changes in logistics processes and identifying value-adding activities (Dmuchowski, 2019, p. 92-94). In particular, the application of AI technology supports cost minimization, quality improvement of services, and increased productivity, which directly translates into better financial results and a stronger competitive position for the company.

Logistics also contributes to building sustainable management strategies, enabling enterprises to quickly adapt to changing market conditions. As Karim *et al.* (2024, p. 1-3) point out, the effective use of logistics not only reduces operational costs but also increases customer satisfaction and strengthens relationships with business partners. The implementation of modern technologies, such as artificial intelligence, further supports decision-making and optimizes operations at both the operational and strategic levels.

As Tjaden & Flämig (2024, p. 2, 3) note, artificial intelligence enables process automation, improving logistics management and eliminating errors. AI supports companies in digital transformation by automating processes related to transport planning, inventory management, and demand forecasting. Research confirms that the application of AI leads to increased efficiency, improved service quality, and reduced operational costs (Geary & Cosgrove, 2023, p. 395, 396). However, the process of implementing AI comes with challenges, such as high costs, the need for organizational restructuring, and concerns related to job losses (Demartini *et al.*, 2019, p. 265-268).

The aim of this study is to assess the degree of application of artificial intelligence technologies in logistics processes and analyze their impact on operational efficiency, using the example of Michelin Poland Ltd. To achieve this objective, the following research questions were formulated:

1. What are the benefits of applying artificial intelligence in logistics?

2. What barriers and challenges do enterprises face during the implementation of AI technologies in logistics?

3. What is the impact of AI implementation on operational efficiency and managerial decision-making in the studied enterprise?

The analysis provides practical insights that may be useful for enterprises considering the implementation of artificial intelligence technologies in logistics.

## Research Methodology

The aim of this research is to assess the extent of artificial intelligence utilization in logistics processes at Michelin Poland Ltd. In particular, the study examined the impact of AI technologies on the company's operational processes and logistics management efficiency.

Michelin Poland Ltd. is one of the largest tire manufacturing plants in Europe, employing approximately 5,000 people. The company, located in Olsztyn, includes six production facilities and a Logistics Center, which served as the focus of this research. Established in 1967 as Olsztyńskie Zakłady Opon Samochodowych, the enterprise became part of the Michelin Group in the 1990s. Today, the company implements modern technologies, including AI, to meet global market demands.

The research was conducted using the direct interview method, employing a detailed questionnaire as the primary tool. The questionnaire was developed based on available literature and previous studies in this area (Idrissi *et al.*, 2024, p. 278, 279; Bhowmik *et al.*, 2024, p. 2, 3). It consisted of 22 questions, designed to address both general topics (e.g., types of AI technologies implemented, implementation timelines) and specific issues (e.g., barriers to adoption, outcomes of AI application, benefits, and risks).

The study was conducted between October 20 and November 22, 2022, at Michelin Poland Ltd., located in Olsztyn. The research sample included 25 respondents, all of whom were men. The majority of respondents were employed in managerial positions (68%), and most held higher education degrees (64%). The participants' work experience ranged from one to 15 years, with the largest proportion (56%) having between 5 and 10 years of experience.

Data were collected from individuals directly interacting with AI technologies in Michelin's Logistics Center. Respondents answered questions regarding the types of technologies used, motivations for implementation, barriers, benefits, and potential risks associated with AI use in logistics processes. The collected data were analyzed using Microsoft Excel, employing descriptive statistical methods such as arithmetic means and frequency analysis. Results were presented using bar and pie charts, as well as percentage distributions, providing a clear representation of the findings.

The methodological approach to the research allowed for the collection of comprehensive data on the implementation and use of artificial intelligence in logistics. The analysis results provide practical insights for enterprises planning to implement modern technologies in their operational processes.

# Results

## Reasons for and barriers to implementing AI

Artificial intelligence was implemented at Michelin Poland Ltd. to improve process efficiency, demand forecasting, and customer service. The primary reason for implementing AI, as identified by respondents, was to enhance workplace safety (76%) (Fig. 1).
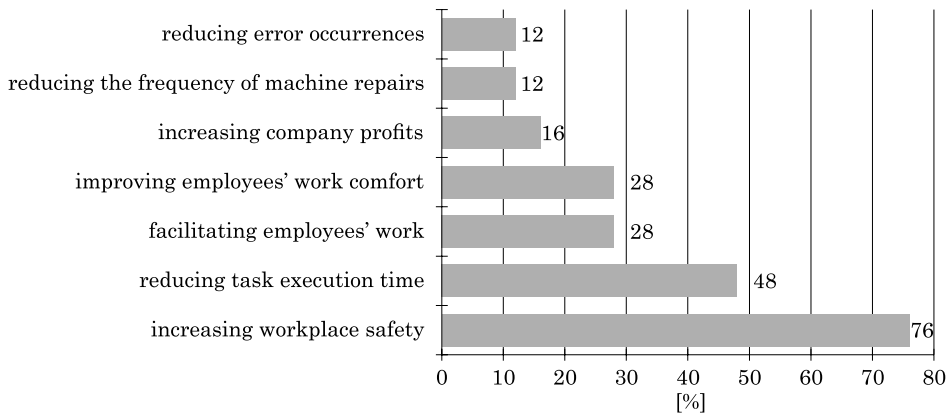


Fig. 1. Reasons for implementing AI in the enterprise (based on the percentage of respondents) Source: own study based on research findings.

Another significant reason for AI implementation, noted by 48% of respondents, was the desire to optimize the time required for task execution. The least cited reasons for adopting AI were minimizing the frequency of machine repairs and reducing error occurrences, both identified by 12% of respondents.

An important issue associated with the implementation of artificial intelligence is the barriers to its adoption within the company. According to 76% of respondents, the most significant challenge is the insufficient competency of employees (Fig. 2).

The second most critical barrier is the lack of adequate knowledge regarding the implementation and optimization of AI-based technologies in the enterprise, as indicated by 20% of the respondents. The least significant barriers, according to respondents, were insufficient digital infrastructure and limited financial resources, both cited by 4% of respondents. According to Sumarlin & Kusumajaya (2024, p. 207, 208), the main challenges of implementing artificial intelligence in industry include integration with legacy systems, data privacy concerns, employee resistance, lack of training and infrastructure investment. This confirms the validity of the research results obtained.
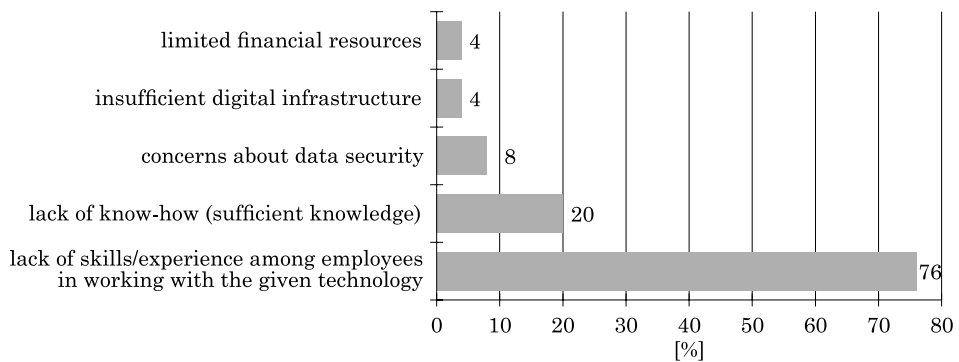
Fig. 2. Barriers in the process of AI implementation in the enterprise (based on the percentage of respondents)
Source: own study based on research findings.

The largest group of respondents (44%) stated that the first benefits of AI implementation became noticeable mainly a year after implementation (Fig. 3).

One in five respondents believed that the initial benefits of AI implementation in the company appeared within six months. Only 16% of respondents noticed benefits as early as one month after implementation, indicating that the adaptation of new technologies is a time-intensive process.
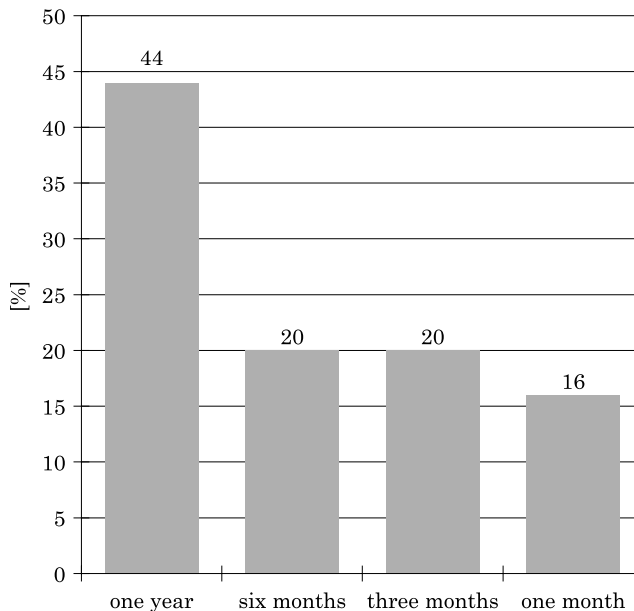


Fig. 3. Time after which the first benefits of AI implementation were observed in the enterprise (based on the percentage of respondents)
Source: own study based on research findings.

# Benefits and risks of implementing AI

The research findings indicate that the most frequently reported benefit of AI implementation was the reduction in labor costs, highlighted by 84% of respondents (Fig. 4). This reduction stemmed not only from the automation of many tasks but also from the ability to maintain high work quality with lower costs associated with training and hiring new employees.
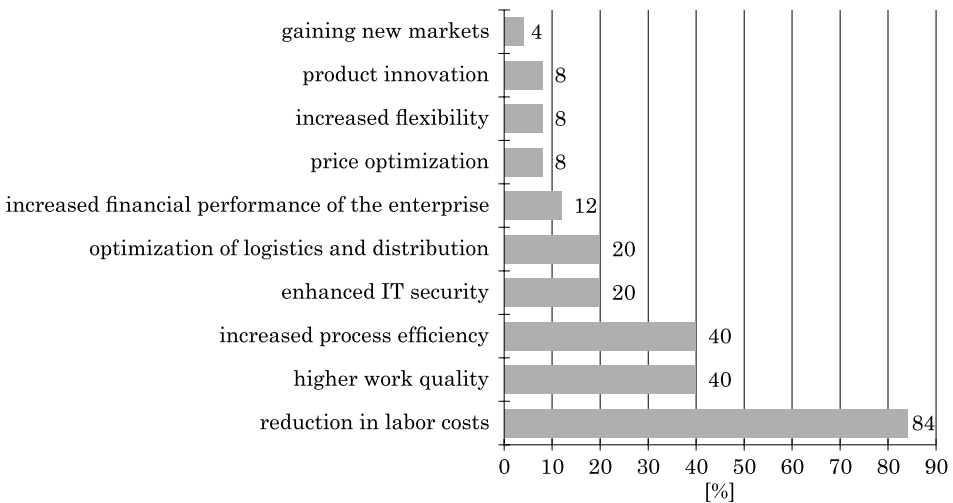
Fig. 4. Benefits resulting from AI implementation in the enterprise (based on the percentage of respondents)
Source: own study based on research findings.

Additionally, 40% of respondents observed increased process efficiency and improved work quality, indicating the positive impact of new technologies on operational activities. However, only 4% of respondents stated that the implementation of AI contributed to entering new markets, likely due to Michelin's already well-established position in the international market. According to Javaid *et al.* (2021, p. 84), artificial intelligence plays a key role in the successful implementation of Industry 4.0, improving product consistency, productivity and reducing operational costs through collaboration between robotics and humans.

The implementation of new technologies in enterprises also involves certain risks. As shown by the research findings (Fig. 5), 44% of respondents identified employee layoffs as the greatest threat.

Although the majority of respondents (44%) reported a low level of concern about job loss, those in lower organizational roles or lacking the necessary qualifications expressed greater anxiety. Other risks included weakened IT system security and reduced system flexibility, each cited by 19% of respondents.
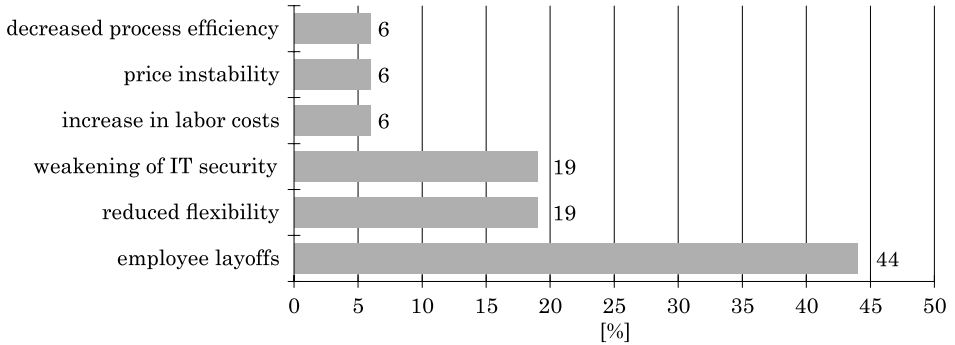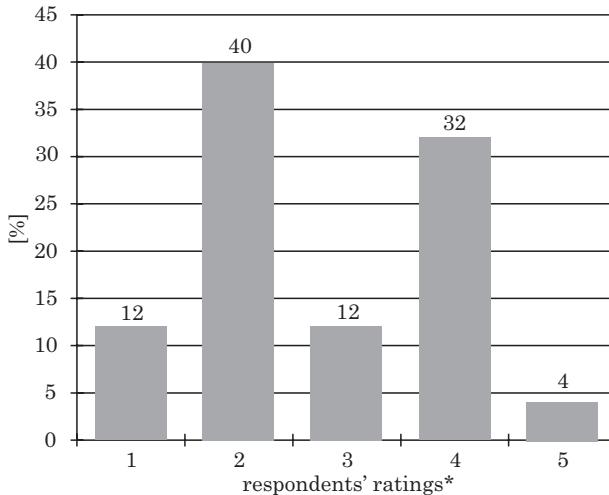
Fig. 5. Risks arising from AI implementation in the enterprise (based on the percentage of respondents)
Source: own study based on research findings.

While smaller groups of respondents noted increased labor costs (6%) or decreased process efficiency (6%), these risks were considered less significant compared to concerns about job stability.

## Employees' attitude towards AI implementation

The collected data suggest that employee attitudes toward the implementation of AI were mostly negative. As many as 52% of respondents expressed a skeptical approach to new technologies (Fig. 6).



* the scale used: 1 – very poor, 2 – poor, 3 – moderate, 4 – good, 5 – very good
Fig. 6. Employees' attitudes toward AI implementation in the enterprise (based on the percentage of respondents)
Source: own study based on research findings.

This skepticism may stem from a lack of knowledge about how AI functions and fears of changes in job responsibilities. Only 48% of respondents had a positive attitude (a score of 3 or higher), highlighting the need for greater managerial involvement in educating and preparing employees to work with new systems. Research by Vogel *et al.* (2023, p. 143, 144) confirms that employees without AI experience tend to reject the technology due to fear of consequences and other factors, which calls for retraining and making employees aware of AI's usefulness.

## Conclusions

The implementation of artificial intelligence at Michelin Poland Ltd. has brought significant benefits in both operational efficiency and the quality of logistics process management. The main reasons for implementing AI, as indicated by respondents, included improving workplace safety and optimizing task execution time. This highlights the critical role of AI in enhancing operational standards and responding to the needs of a dynamically changing business environment.

One of the most important advantages of AI implementation was the reduction in labor costs, achieved through process automation and increased operational efficiency. AI also positively influenced work quality, underscoring its role as a tool for supporting both productivity and innovation within the company. At the same time, it was observed that AI implementation rarely led to the acquisition of new markets, likely due to the company's stable and established position in the international market.

The process of implementing AI faced significant barriers, such as insufficient employee competencies and a lack of knowledge about new technology implementation. This underscores the need for investments in training and the development of skills related to AI management and utilization. Infrastructure deficiencies and limited financial resources were considered less significant obstacles, suggesting that organizational and educational aspects of AI implementation are critical to the success of the transformation process.

Despite the overall success of AI implementation, certain risks emerged, including employee concerns about job loss. The negative attitude of some team members toward new technologies was primarily driven by a lack of knowledge and uncertainty about how AI would affect their daily responsibilities. Therefore, it is essential to introduce measures to support team adaptation to these changes, such as transparent communication and the implementation of training programs.

In summary, the implementation of AI at Michelin Poland Ltd. has brought many benefits but also posed challenges. The key takeaway is the necessity of a balanced approach to adopting new technologies that considers both technological development and employee needs. Investments in skill development,

education, and transparent change management are essential to maximizing the benefits and minimizing the risks associated with technological transformation.

## Limitations and Recommendations for the Future

The primary limitation of this study is the small and homogeneous sample, which consisted of 25 male respondents from one organization, Michelin Poland Ltd. This narrow scope limits the generalizability of the results, as it does not adequately account for the diversity of experiences across industries, regions or demographic groups. In addition, focusing on one company limits the contextual scope, potentially overlooking differences in how artificial intelligence technology is implemented and perceived in different organizational environments.

To address these limitations, future research should include larger and more diverse samples, including respondents from different industries and regions to increase representativeness. Comparative studies across multiple companies or sectors could also provide valuable insights into broader trends in artificial intelligence deployment. Moreover, exploring strategies to overcome barriers, such as insufficient employee skills and high implementation costs, would add practical value. Longitudinal studies to assess the long-term impact of AI and taking into account local contextual references, particularly in Poland, would also enrich the relevance of future research for national stakeholders. By addressing these areas, future research can provide more comprehensive and practical insights into the role of AI in logistics.

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