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ARTIFICIAL INTELLIGENCE AND AUTOMATION INTEGRATION OPPORTUNITIES IN WHOLESALE COMPANIES: QUANTITATIVE RESEARCH RESULTS AND STRATEGIC INTEGRATION ROADMAP

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Abstract. This article analyses the possibilities for integrating artificial intelligence (AI) and automation technologies in wholesale companies based on quantitative research and the latest statistical data. The aim of the study is to deter-mine the opportunities, benefits, application areas, functions, and challenges related to AI and automation integration in the wholesale sector. The study reveals that although the level of AI and automation technology adoption in wholesale companies remains relatively low (EU average in 2024 – 13.48%), market growth forecasts (CAGR 9.39% by 2034) and respondents' perceptions indicate significant future development potential. The greatest benefits of AI and automation are observed in logistics, transportation, accounting and production process optimisation, while the main challenges include high initial investment costs, lack of strategic planning, insufficient employee competencies, and social implications. The results confirm that successful integration of AI and automation depends on human resource readiness, strategic planning, and consistent implementation, while the benefits of technology are perceived positively in terms of efficiency, cost reduction, and competitive advantage contexts.

Keywords: artificial intelligence, automation, wholesale trade, logistics optimisation, technology integration, quantitative research, innovation, supply chain, efficiency, investment.

JEL Classification: M31, L84.

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1. Introduction

Wholesale companies operate as an intermediary link between manufacturers and retail chains or other business customers, with their main objective being to ensure an uninterrupted supply of goods to the market (Larutama et al., 2022). Traditional process management methods, based on manual operations and fragmented digital systems, often fail to ensure adequate efficiency, accuracy, and speed, resulting in lower customer satisfaction and loyalty (Mulla, 2022).

The main problems of traditional models are the lack of real-time data, limited operational visibility, manual inventory tracking, and slow and inaccurate information flow between organizational units (Ali et al., 2024). With the rapid development of logistics and supply chain management, the integration of advanced technologies – automated warehouse management systems and artificial intelligence – is becoming essential in order to achieve greater efficiency and accuracy (Sodiya et al., 2024; Ailyn, 2024).

AI-based automation systems use advanced algorithms to enable companies to respond more quickly and accurately to market fluctuations and changing customer needs (Olakunle et al., 2024). However, integration is not a one-time implementation project – it is an iterative cycle requiring strategic planning, employee engagement, and organizational flexibility (Cooper, 2025).

The scientific problem formulated in the article is that wholesale companies often fail to integrate AI and automation technologies optimally because integration is understood only as a technical implementation rather than a consistent, feedback-driven transformation process. As a result, expected efficiency and competitiveness outcomes are not achieved despite the potential of implemented systems.

The object of the research – the integration of artificial intelligence and automation into wholesale companies.

The aim of the research – to identify the possibilities of integrating AI and automation in wholesale companies and, based on the research results, to develop a theoretical implementation model.

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Research objectives:

1. To analyse theoretical aspects of AI and automation application in wholesale companies.
2. To identify AI and automation usage trends in EU enterprises based on statistical data (Eurostat, 2024; Statista, 2024a).
3. To develop a methodology for research on AI and automation integration in wholesale companies.
4. To empirically assess the possibilities of AI and automation integration in wholesale companies.
5. To create a theoretical AI and automation integration implementation model.

2. Theoretical approach: automation and artificial intelligence integration in wholesale trade

2.1. The concept of automation and integration challenges

Automation is defined as the execution of processes or tasks with reduced human involvement compared to manual processes; automated systems can combine processing, assembly, inspection, and material handling in one system (Affiah et al., 2022). AI-based automation systems optimize various operational aspects – from inventory management to order fulfilment – by applying advanced algorithms, thereby increasing efficiency and flexibility of warehouse operations (Olakunle et al., 2024; Naujokienė et al., 2025).

An example of automation in wholesale companies is an ***automated warehouse management system,*** which enables the automation and optimization of stock turnover processes, accurate inventory tracking, efficient resource allocation, and uninterrupted warehouse operations (Ailyn, 2024; Al Bashar, 2024). Such systems include inventory management, receiving and put-away, picking and packing, slotting, workforce management, analytics tools, and integration with other enterprise systems (Ailyn, 2024; Al Bashar, 2024).

Scientific literature highlights the key advantages and challenges of automation: advantages include improved inventory accuracy, faster order fulfilment, warehouse space optimization, increased productivity, and data-driven decision-making; challenges include high initial investment, ongoing maintenance costs, complex integration with existing systems, employee resistance to change, and data security risks (Mulla, 2022; Larutama et al., 2022; Shanmugamani & Mohamad, 2023; Clegg & Sarkar, 2024).

A crucial condition for successful automation integration is a ***consistent implementation strategy,*** which includes requirement analysis, vendor selection, system architecture design, integration with existing systems, data migration, and pilot testing in a controlled environment (Rizki et al., 2023; Shirouyehzad et al., 2011; Rana, 2023; Al Bashar, 2024; Clegg & Sarkar, 2024; Scott & Hoover, 2024). A rushed or inconsistent integration process may disrupt the supply chain, cause data duplication, inaccuracies in customer information, and failure to achieve expected efficiency improvements (Mulla, 2022).

2.2. The role of artificial intelligence in inventory and order management

Artificial intelligence is defined as a technology enabling machines to operate similarly to humans – learn from experience, analyse data, solve problems, understand natural language, recognize images, and make decisions (Angammana & Jayawardena, 2022). As a cornerstone of the Fourth Industrial Revolution, AI relies on advanced analytical methods such as machine learning and deep learning to imitate human intelligence and support rational decision-making (Singh et al., 2024).

In wholesale companies, AI plays a key role in transforming inventory management (Olakunle et al., 2024). By analyzing historical sales data, market trends, and external factors (e.g., weather, economic indicators), AI enables more accurate demand forecasting, reduces excess and shortage of inventory, and optimizes replenishment cycles (Olakunle et al., 2024).

Another important application area is ***order management and warehouse operations.*** AI integration with automated systems enables optimized picking routes, priority-based order sequencing, management of packing and sorting processes, tracking key performance indicators (KPIs), and predictive maintenance of equipment, thus reducing downtime and repair costs (Zöls et al., 2024; Sied, 2024; Olakunle et al., 2024).

However, AI adoption raises ethical, privacy, and security concerns – reliable data encryption, access control, cybersecurity measures, and mitigation of algorithmic bias and discrimination risks must be ensured (Sied, 2024; Li, 2024; Olakunle et al., 2024).

2.3. Integration challenges and research gaps

Systematic literature reviews indicate that although numerous publications discuss advanced technologies in supply chains, most focus on conceptual analyses, case studies, or technological descriptions, but lack large-scale empirical research on practical implementation in wholesale sectors (Teixeira et al., 2025). Bari (2023) found that out of 1058 identified publications, only 30 directly examined integration of advanced technologies in wholesale and distribution, demonstrating a significant research gap.

Cooper (2025) identifies four stages of AI integration in wholesale supply chains. Hendriksen (2023) additionally emphasizes the role of employees' perceptions and attitudes, highlighting that employee interpretation determines whether AI becomes a widely integrated practice or remains merely an auxiliary tool.

Overall, automation and AI integration is a ***complex technical and social process*** requiring strategic planning, appropriate software selection, high-quality data, and consistent employee engagement.

Two hypotheses are formulated:

H1. *The integration of AI and automation in wholesale companies depends on human resource competencies, readiness for change, and the ability to adapt to technological innovation.*

H2. *AI and automation integration is an* ***iterative process*** *in which implementation, evaluation, and improvement occur continuously according to feedback-based logic, rather than as a single event (Cooper, 2025).*

3. Research methodology

3.1. Analysis of statistical data

Sullivan and Wamba (2024) conducted a study in which a two-stage survey was carried out, seeking to survey corporate information technology managers and business decision-makers. It was revealed that artificial intelligence technologies used to automate business activities can provide value to organizations through their ability to directly influence how companies recognize and respond to market changes. Ajiga et al. (2024), in their article, emphasize that the automation of enterprise software has become an essential force improving industrial performance. It transforms the approach to efficiency and productivity. In this way, software automation will contribute to profit growth.

According to data from the online statistical platform "Statista", it is estimated that the global industrial automation market size in 2025 will reach 256.02 billion US dollars, and it is forecast that by 2034 it will grow to 569.27 billion US dollars. A view of the data growth trends for the period from 2024 to 2034 is presented, in which a consistent annual increase in the industrial automation market is observed (see Figure 1). The compound annual growth rate (CAGR) is calculated using the formula:

$$CAGR = \left(\frac{V_f}{V_i}\right)^{\frac{1}{n}} - 1,$$

where V_f – final value of the industrial automation market, V_i – initial value of the industrial automation market, n – number of years (2024–2034).

$$CAGR = \left(\frac{569.27}{233.81}\right)^{\frac{1}{10}} - 1 = \sqrt[10]{2.434} - 1 \approx$$

$$1.0939 - 1 = 0.0939 = 9.39 \text{ pct.}$$

Applying the figures (V_f = 569.27; V_i = 233.81; n = 10) produces a CAGR value of approximately **9.39%.**

According to a study conducted by research, the largest share of this market belongs to three most economically developed regions – Asia, Europe and North America – together accounting for approximately **90%** of the global market. The shares of other regions are smaller: Latin America accounts for about **7%,** while the Middle East and Africa represent around **3%.** These indicators show that industrial automation is mainly concentrated in economically strong regions with the highest technological investment and advancement.

As shown in Figure 2, the companies that most frequently used artificial intelligence technologies for automation in 2023 and 2024 across the European Union were large enterprises with 250 or more employees. Their AI usage ratio reached 30.4 percent in 2023 and increased to 41.17 percent in 2024. Respectively, the ratios for small (10–49 employees) and medium-sized (50–249 employees) companies also increased. In 2024, the use of artificial intelligence in small enterprises grew from 6.38 percent to 11.21 percent, while in medium-sized enterprises it increased from 13.04 percent to 20.97 percent.

Although enterprises of all sizes recorded growth, the overall artificial intelligence usage rate across all enterprises in 2024 reached only 13.48 percent, suggesting that the artificial intelligence adoption potential in European Union enterprises has not been fully exploited and remains at an early stage – representing a growing innovation that can be successfully applied in wholesale company operations.

According to Eurostat 2024 data on EU economic operators using artificial intelligence and other automation technologies, collected from enterprises with at least 10 employees, the sectors where these modern technologies

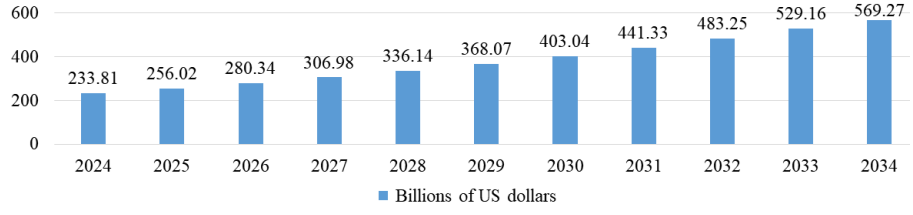


Figure 1. Forecast industrial automation market size for 2024–2034 (source: Statista, 2024b)

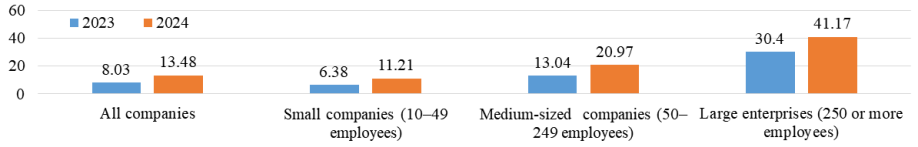


Figure 2. EU enterprises using artificial intelligence technologies in 2024 by enterprise size (source: Eurostat, 2024)

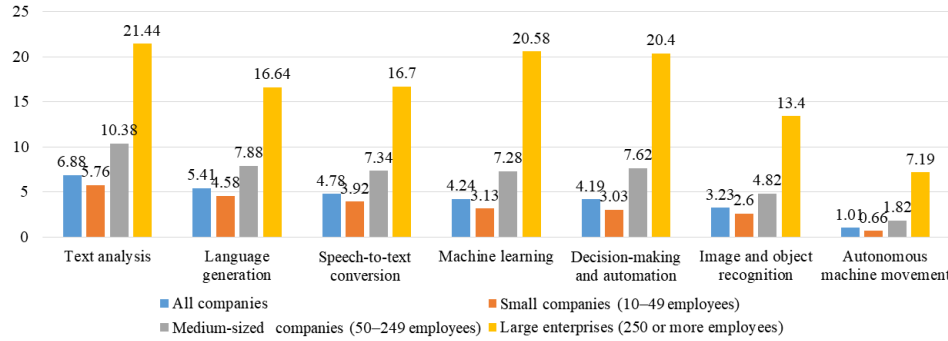


Figure 3. EU enterprises using artificial intelligence technologies in 2024 by type of AI technology (source: Eurostat, 2024)

are most frequently used were identified. The largest share of AI usage was recorded in the information and communication sector – 48.72 percent – and in professional, scientific and technical services – 30.53 percent. Meanwhile, the automation level of the manufacturing sector reached approximately 11 percent, and the transportation and storage sector reached about 8 percent. The low figure in transportation and storage suggests that there remains considerable growth potential in this area.

Based on the type of artificial intelligence technology, Eurostat, the statistical office of the European Union, identified seven areas of application in small, medium-sized, and large enterprises in 2024 (see Figure 3).

Wholesale enterprises, according to 2024 Eurostat data, used all seven defined types of artificial intelligence technologies in their activities (see Table 1). The highest share – 5.98 percent – used artificial intelligence for automated text processing and text comprehension and interpretation. A total of 5.03 percent used artificial intelligence for written and spoken language generation, i.e., generating text from structured information, while 3.83 percent used artificial intelligence for converting speech into digital format – speech recognition.

Meanwhile, 2.96 percent of wholesale enterprises used artificial intelligence for data analysis using machine learning to make decisions without explicit forecasting. Culot et al. (2024) conducted a systematic literature review applying the mirrored analytical method to identify further research directions relevant to understanding artificial intelligence application in supply chain management. After analyzing 123 scientific sources published between 2010 and 2024, it was determined that machine learning is the dominant research topic.

Wholesale companies using artificial intelligence technology focus most on marketing and sales objectives – 45.95% (see Table 2). This suggests that nearly half of European Union wholesale companies use artificial intelligence for marketing and sales purposes. Such an indicator allows us to assume that wholesale companies increasingly recognize the importance of artificial intelligence in attracting new customers, increasing sales efficiency, and improving overall operational performance.

Almost one-quarter (24.89 percent) of wholesale companies use artificial intelligence for the organization or management of business administration processes.

Almost one-fifth of all wholesale companies in 2024 applied artificial intelligence in accounting, control and financial management (18.88 percent) and security, reliability and resilience to threats (19.67 percent). Artificial intelligence technology was used for production processes by 13.16 percent of wholesale companies, which may indicate that companies providing the survey data do not necessarily engage in manufacturing activity or that it is not their primary business function.

Table 1. EU wholesale enterprises using artificial intelligence technologies in 2024 by type of AI technology (source: Eurostat, 2024)

Text analysis	Language generation	Speech-to-text conversion	Machine learning	Decision-making and automation	Image and object recognition	Autonomous machine movement
5.98	5.03	3.83	2.96	3.24	2.63	0.80

Table 2. EU wholesale companies using artificial intelligence technologies in 2024 by area of application (source: Eurostat, 2024)

Marketing and sales objectives	Organization or management of business administration processes	Production processes	Accounting, control, or financial management	Security, reliability, and resistance to threats	Scientific research and technological development or innovative activities	Logistics
45.95	24.89	13.16	18.88	19.67	9.60	9.56

The least attention is given to scientific research, technological development and innovation (9.60 percent) and logistics (9.56 percent).

The completed statistical data analysis revealed that artificial intelligence is an innovative solution of a growing market, aimed at automating enterprise operational processes. Although, according to 2024 Eurostat data, only 13.48 percent of all surveyed companies used artificial intelligence in their operations – most of which were large enterprises with 250 employees or more (41.17 percent) – the projected 9.39 percent growth of the industrial automation market between 2024 and 2034 suggests that this share will increase in the future, creating favorable conditions for wholesale enterprises to enable the integration of new technologies into their operations.

3.2. Empirical research and sample

The empirical research applied a ***quantitative method*** – a structured anonymous questionnaire survey, the purpose of which was to assess the significance of artificial intelligence and automation integration, its application areas, functions, benefits and challenges in wholesale companies. The quantitative method was chosen due to its reliability, repeatability and the possibility to evaluate relationships between variables more objectively (Kardelis, 2002; Creswell, 2014; Queirós et al., 2017). This approach also aligns with the philosophy of science perspective in management research, as highlighted by Lisiński et al. (2026), emphasizing systematic, theory-driven, and empirically verifiable inquiry.

The sample size was calculated according to the formula provided by Gravetter and Wallnau (2017), applying a 95% confidence level, a 0.5 expected proportion and a 10% margin of error. The minimum required sample size obtained was 97 respondents; in practice, 116 respondents were surveyed, which exceeds the minimum requirement (Gravetter & Wallnau, 2017).

Before conducting the research, in order to ensure that the obtained results would be reliable and representative of the entire study population, the sample size calculation was performed using the sample size formula (Gravetter & Wallnau, 2017):

$$n = \frac{Z^2 \times p \times (1-p)}{e^2},$$

n – required sample size; Z – confidence level (in social science quantitative surveys the standard is 95%); p – expected proportion (when the exact proportion is unknown, 0.5 is applied); e – allowable margin of error (for a small-scale study, 10% is applied).

$$n = \frac{1.96^2 \times 0.5 \times (1-0.5)}{0.10^2} = 96.04.$$

Considering the calculated required sample size, in order to obtain reliable results, no fewer than 97 respondents were required. The research respondents were surveyed anonymously, therefore no personal data were disclosed, and participation in the study was voluntary, with respondents being informed that the results would be used solely for scientific purposes. To ensure the reliability of the research data, respondents were required to have work experience and qualifications in wholesale company activities or in the provision of logistics services to such companies. The study did not take into account respondents' age or gender.

The research questionnaire was constructed following the principles of a structured questionnaire in order to ensure comparability of the obtained results and analytical accuracy. In total, respondents were provided with 33 questions, of which 6 were closed-ended questions with answer options, 5 were semi-open questions with answer options and an opportunity to provide an additional answer, and 22 were scale-based evaluation questions, designed to obtain respondents' assessments for analyzing the research problem and creating an integration model.

The first three closed-ended questions of the research questionnaire were intended to determine respondents' demographic data: the field of company activity, the company size based on the number of employees, and the duration of company operations. These demographic data were used to analyses how the integration of artificial intelligence and automation into wholesale companies may differ depending on the company's activity type, its scale and accumulated experience. Demographic data also helped conduct a more precise results analysis to assess whether a relationship exists between company characteristics and its attitude toward the integration of artificial intelligence and automation into wholesale companies (Table 3).

Table 3. Demographic data of research respondents

Company activity field	Food products wholesale	19.83
	Alcoholic beverages wholesale	10.34
	Industrial goods wholesale	15.52
	Logistics / transport services	54.31
Company size	Up to 10 employees	7.76
	10–49 employees	56.03
	50–249 employees	30.17
	250 or more employees	6.04
Company operational duration	Up to 5 years	7.76
	5–10 years	19.83
	10–20 years	56.90
	20 or more years	15.51

A total of 116 respondents were surveyed in the study. Based on the collected research data, it was determined that the largest share of respondents (54.31 percent) consisted of employees working in the logistics and transport departments of wholesale companies. Respectively, 19.83 percent of respondents represented food products wholesale, while 15.52 percent represented industrial

goods wholesale. The smallest share of surveyed respondents consisted of representatives of alcoholic beverages wholesale – 10.34 percent. Considering the demographic characteristics of respondents, it can be stated that the surveyed respondents are closely related to the analyzed problem, which allows us to assume that the research results are important and valuable in evaluating the integration of artificial intelligence and automation into wholesale company operations (Table 4).

Table 4. Respondents' job roles and international activity of represented companies

Role in the company	Export	24.06
	Import	17.19
	Logistics / transport	30.94
	Warehousing	10.63
	Purchasing / sales	13.13
	IT technologies	2.5
	Other	1.55
International company activity	Activity conducted internationally	88.79
	Activity not conducted internationally	4.32
	Planned international activity	6.03
	Unknown	0.86

Further research data were used to assess respondents' roles within the company to determine their functions related to wholesale company operations. The results revealed that the largest share of respondents consisted of representatives of logistics and transport departments – 30.94 percent, who directly participate in product movement processes within wholesale companies. A significant proportion of respondents are responsible for export (24.06 percent) and import (17.19 percent) functions within wholesale companies, suggesting that most of these respondents participate in international trade with foreign countries.

Company activity in international markets was also examined. As many as 88.79 percent of respondents stated that their company operates internationally, and 6.03 percent indicated that such activity is planned in the future, while only 4.32 percent stated that international activity is not conducted and is not planned. Such respondent distribution suggests that surveyed company representatives represent organizations operating in international markets, which confirms a high level of sample internationalization.

4. Research results

The level of artificial intelligence and automation application. First, the aim was to determine whether wholesale companies already apply artificial intelligence and / or automation. To assess the overall level of technology application, artificial intelligence and automation were evaluated as a ***single complex phenomenon,*** considering the fact that many automation solutions are based on artificial intelligence functions.

The research results revealed that:

- 45.69% of respondents' companies ***already apply*** artificial intelligence and/or automation solutions;
- 36.21% of companies ***do not apply*** these technologies;
- 11.21% indicated that the application of these technologies ***is planned;***
- 6.9% of respondents stated that they ***do not know*** whether their company applies such technologies.

This indicates that a large share of wholesale companies still rely on traditional process management methods; however, at the same time, a clear positive development trend is emerging – a significant proportion of companies are considering the implementation of these technologies in the near future.

Despite uneven practical adoption, the benefits of artificial intelligence and automation are evaluated positively: 36.21% of respondents rated the technologies as ***very useful,*** 34.48% – as ***useful,*** 12.93% – as ***moderately useful,*** while 16.38% of respondents considered the technologies to be not useful or completely not useful.

Areas and functions of technology application. The analysis of technology application areas revealed that artificial intelligence and automation in wholesale companies are most commonly assigned to:

- ***logistics and transport*** process management – 31.25%;
- ***accounting, control and financial management*** – 24.22%;
- ***production processes*** – 17.19%;
- ***marketing and sales*** – 12.89%;
- ***business administration processes*** – 6.64%.

The least frequently mentioned areas are security and resilience to threats (**3.52%**), scientific research and innovation (**9.60%** – according to both Eurostat and empirical data), and "other" areas (**1.95%**) (Eurostat, 2024). This means that wholesale companies most often direct technologies toward ***operational processes***, where the impact is easiest to measure, while the potential in strategic activities is not yet fully exploited.

When analyzing the functional directions of artificial intelligence and automation application, it was found that the best-known and most frequently applied functions among respondents are ***decision-making***, ***machine learning***, and ***text analysis***. Meanwhile, autonomous solutions (e.g., autonomous robots, drones) are both known and used rarely, and **20.5%** of respondents indicated that they do not use any of the listed functions. This confirms that most wholesale companies apply artificial intelligence more for ***analytical and decision-support purposes*** rather than in fully autonomous physical processes.

Benefits of integration. A series of statements reflecting the added value of artificial intelligence and automation for wholesale companies was formulated for the study. Respondents' answers revealed a clearly positive attitude toward the benefits of these technologies.

The highest level of agreement was expressed with the following aspects of artificial intelligence application:

- ***optimisation*** of inventory and warehousing;
- ***faster and data-driven decision-making***;
- increasing ***competitive advantage***.

Artificial intelligence benefits related to customer service quality and demand forecasting were evaluated more cautiously – some respondents expressed doubts about the accuracy and reliability of these areas.

When evaluating the benefits of automation, most respondents agreed that automation:

- ***reduces operational costs***;
- ***increases operational efficiency***;
- ***reduces the likelihood of human error***;
- ***enables more flexible responses to changes***;
- ***may reduce the need for human resources***.

Such results confirm the advantages of automation highlighted in scientific literature and show that representatives of wholesale companies clearly recognize the potential of these technologies in efficiency, cost and quality management (Mulla, 2022; Al Bashar, 2024).

Integration challenges: investments, strategy and supply chain. In addition to assessing benefits, an essential part of the study involved identifying integration ***barriers***. The research results showed that:

- as many as **97.14%** of respondents agree that the implementation of artificial intelligence and automation requires significant initial investments;
- **74.29%** of respondents agree that wholesale companies experience a lack of a ***clear technology integration strategy***.

This corresponds with problems discussed in scientific literature, related to high licensing, implementation, integration and maintenance costs, as well as difficulties in evaluating return on investment (Clegg & Sarkar, 2024; Shanmugamani & Mohamad, 2023).

Respondents also agree that:

- artificial intelligence and automation integration may ***disrupt regular operations in the short term***;
- improper integration may ***disrupt the entire supply chain***.

This confirms the necessity of following a consistent integration strategy, performing pilot testing in a controlled environment and implementing new systems in stages, as recommended in theoretical automation models (Rizki et al., 2023; Rana, 2023; Al Bashar, 2024; Scott & Hoover, 2024).

Social aspects and employee resistance. The study revealed a pronounced ***social dimension*** of integration. As many as **79.99%** of respondents indicated that employees feel resistance to technological changes, and **62.86%** stated that employees feel insecure due to the possible loss of jobs. This supports Hendriksen's (2023) viewpoint that artificial intelligence integration is not only a technological process but also a social one, in which employee experiences, perceptions and expectations play a decisive role.

In addition, more than half of respondents agree that:

- artificial intelligence may be ***inaccurate or biased***;
- automation increases ***dependence on technologies***;
- the application of artificial intelligence and automation poses ***data security risks***.

This demonstrates the need to strengthen digital literacy, transparently inform employees about the functioning of technologies, security mechanisms and implemented data protection measures, and also ensure that human judgment remains in place in critical processes (Li, 2024; Sied, 2024).

5. Theoretical model for the integration of artificial intelligence and automation into wholesale companies

Based on the conducted quantitative research and theoretical analysis, a step-by-step ***theoretical model for integrating AI and automation into wholesale companies*** was developed. Its purpose is to help companies systematically and consistently plan and implement the integration of smart technologies, reducing technical, financial and social risks.

Relevance of the theoretical model. Wholesale companies constantly face structural changes due to increasing customer demands, growing product variety, accelerating supply chains, and the necessity to reduce operational costs. Traditional business models are becoming insufficiently effective; therefore, AI and automation integration is shifting from a possibility to a necessity in order to ensure long-term competitiveness. Statistical data demonstrate rapid growth in the technology market (Statista, 2019), making it relevant not only to consider *whether* to implement technologies, but *how* to do so in a consistent and controlled manner.

Companies seeking to integrate AI and automation often face:

- fragmented and uncoordinated processes,
- insufficient data quality,
- lack of digital skills,
- unclear investment return criteria.

Therefore, ***a precise and structured theoretical integration model*** is needed to help understand integration principles, evaluate risks, factors, and their interrelationships. The model provides a methodological basis for making data-driven decisions, planning integration stages, and systematically managing change.

Structure of the model and the stepwise principle. The developed theoretical model consists of six sequential implementation stages (see Figure 4):

1. Strategy development,
2. Data collection,
3. Implementation,
4. Testing,
5. Evaluation,
6. Continuous improvement.

The model is based on a ***stepwise principle***: each stage is implemented sequentially, only after checking and evaluating the results of the previous stage. An inadequately executed or skipped stage increases the risk of overall project failure. The model is cyclical – the results of analysis and evaluation may require returning to earlier stages to adjust decisions and processes.

The first stage – ***strategy development*** – involves a comprehensive ***analysis of the current situation***, including processes such as warehousing, order management, logistics, finance, and customer service, as well as an assessment of the existing technological landscape and IT infrastructure, the prospective investment budget, and the competitive environment. In addition, a ***risk assessment*** is conducted, addressing the desired payback of investments, potential dependency on new systems, data security considerations, and the likelihood of employee resistance. Finally, **objectives** are formulated at three levels: ***strategic*** (enhancing competitiveness, improving quality, and supporting long-term growth), ***operational*** (specific process indicators such as order processing time, the number of errors, etc.), and ***financial*** (initial investment, expected payback, and return on investment).

Based on these assessments, an ***action plan*** is prepared, specifying tasks, resources, responsibilities, and timelines.

The second stage – ***data collection*** – focuses on identifying the key operational ***processes and functions*** to be automated or optimized through AI and on analyzing ***data quality*** by assessing accuracy, completeness, duplication, and the legitimacy of access, while addressing data gaps and inconsistencies. It also examines ***integration capabilities*** with existing systems (ERP, SVS, TMS); where necessary, decisions are made regarding the adaptation or modernization of legacy systems, alongside an assessment of IT infrastructure and security requirements. Lastly, based on the collected information, ***supplier selection*** is carried out by choosing the technology platform or system that best matches organizational needs.

The essence of this stage is to ensure that AI and automation solutions are based on ***high-quality, integrated and secure data***.

The third stage – ***implementation*** – entails deploying the selected ***system*** and performing its ***configuration*** in line with organizational processes and technological requirements. To verify core functionality and interfaces with existing systems, ***pilot data*** are introduced and ***pilot-environment testing*** is conducted. Following a successful pilot, data are migrated to the new system, with particular emphasis on ***data security***, including the definition of **user roles** and **access** rights to ensure that data is available

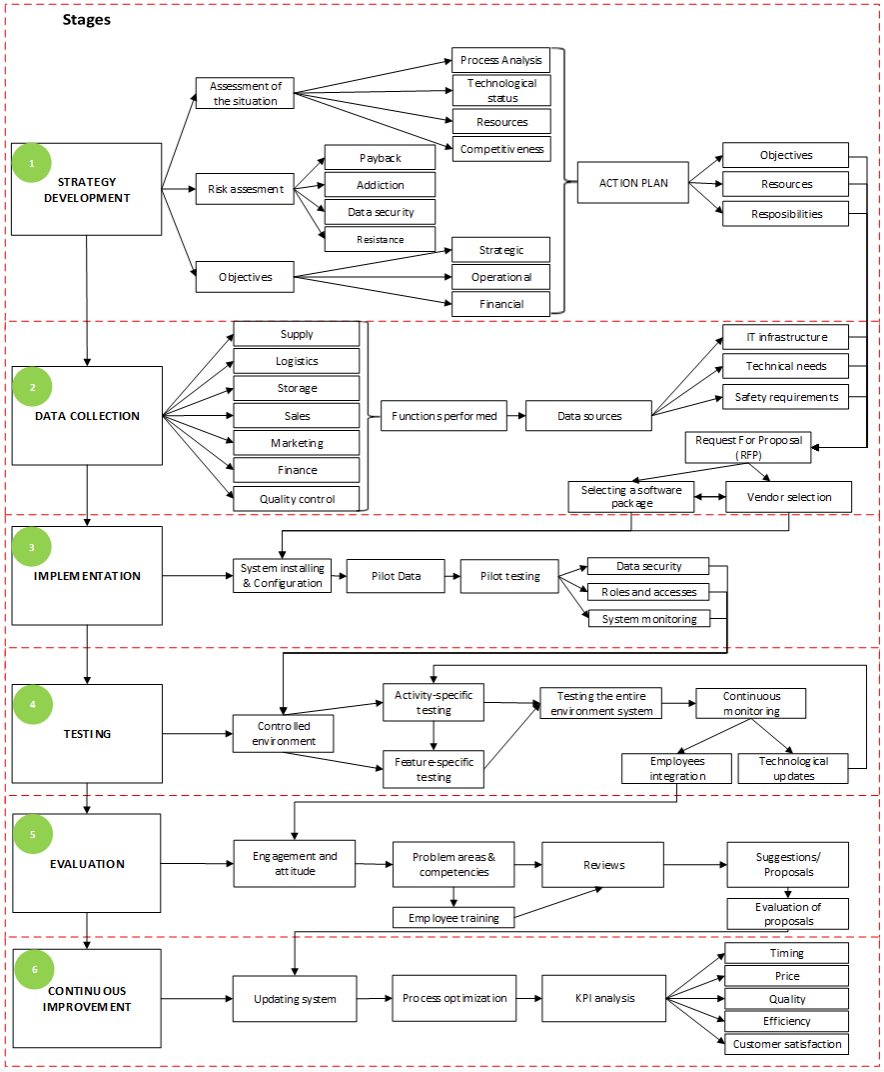


Figure 4. The implementation model of artificial intelligence and automation integration into wholesale companies

only to authorized employees. In addition, ***continuous system monitoring*** is implemented to detect operational disruptions or anomalies in real time.

If errors arise during data migration or system implementation, it is necessary to return to the previous configuration and testing step until a stable operating state is achieved.

The fourth stage – ***testing*** – begins with evaluating the system in a ***controlled, small-scale environment*** (for example, within a single warehouse or operational process) to manage potential errors and disruptions, identify and rectify ***technical*** and ***process-related*** issues, and assess system stability and performance. After successful testing in the controlled setting, the organization proceeds to ***full-scale system testing in the real operational environment***. Given that systems are continuously updated, periodic retesting is recommended.

This testing stage reduces the risk that deployed technologies will disrupt critical business processes.

The fifth stage – ***evaluation*** – places particular emphasis on the social dimension. It assesses ***employee engagement and attitudes*** towards AI and automation, determines whether employees ***lack knowledge and competencies*** and whether they understand the purpose and benefits of the technologies, and includes the delivery of employee training. In addition, ***employee feedback*** is systematically collected and classified as positive or negative to identify problematic **areas** and ***improvement proposals***. It is further emphasized that AI and automation are intended not to replace employees, but to take over routine tasks, thereby enabling employees to devote greater attention to higher-value activities.

In this way, the model integrates the ***human resources dimension*** into the technology implementation process.

The sixth stage – ***continuous improvement*** – involves the regular analysis of key performance indicators (KPI), such as order processing speed, inventory accuracy, the number of errors, employee efficiency, and customer satisfaction. If KPI do not indicate improvement or if results deteriorate, problem areas are identified by determining the specific process and function where issues occur. Where the underlying cause cannot be identified, the organization returns to the ***testing stage***, implements corrective actions, and then proceeds again through the implementation, evaluation, and improvement stages in a cyclical manner. Conversely, if KPI improves, the model is considered effective, and the organization may return to the ***strategy development*** stage to set new objectives and further expand the application of AI and automation.

This creates a cyclical, feedback-based integration process that corresponds to hypothesis H2.

The final theoretical model is constructed according to the stepwise principle, where each previously implemented step is thoroughly checked and evaluated before proceeding to the next step. The subsequent implementation step also involves verification until the final implementation stage is reached (see Figure 4). Each stage of the theoretical model for integrating automation and artificial intelligence into wholesale companies is equally important and significant. The stepwise principle forms a consistent, cyclical process in which each step determines the quality of subsequent stages and the overall effectiveness of the model. Skipping or insufficiently performing any stage may create a risk to the success of the entire project. For this reason, the model emphasizes the importance of strategy development, consistency, feedback, and continuous improvement, enabling wholesale companies to adapt to technological change and ensure long-term development prospects.

The uniqueness of the theoretical model lies in the fact that technologies are viewed not only as superior tools improving wholesale business process efficiency compared to traditional management methods, and not only as something companies must adopt quickly in order to remain competitive, but as a ***complex implementation process*** that encompasses strategic, organizational, technological and social aspects.

At the ***strategic level***, a specific action plan for the wholesale company is prepared, based on assessment of the current situation, risks, goal setting, tasks, available resources and distribution of responsibilities.

At the ***operational level***, work proceeds to specific business processes of the wholesale company, such as supply, logistics, warehousing, sales, marketing, finance and quality control. The specific functions within these processes are analyzed to collect existing data on potential integration possibilities and applicability of AI and automation. After that, a specific software vendor is selected that meets organizational expectations.

At the ***technological level***, the technologies themselves are implemented: integration with existing systems is created, data security is ensured, roles and access rights are established, system testing is carried out in a controlled environment, and, if successful, across the entire wholesale company environment. Continuous monitoring is also carried out to ensure operational functionality.

At the ***social level***, efforts are made to involve employees in the technology integration process. Using feedback principles, employee engagement and attitudes toward integration are evaluated; problem areas are identified; if needed, training is organized; and employee feedback is collected to identify potential improvement opportunities.

Finally, continuous system updates are carried out to optimize business processes.

6. Discussion

The research results and the developed theoretical model confirm that the integration of AI and automation in wholesale trade is a complex, ***multidimensional process*** that requires:

- a clear strategic foundation;
- high-quality, integrated data;
- appropriate technological infrastructure;
- active employee engagement and continuous feedback.

The empirical study showed that a large proportion of companies already apply or plan to apply AI and automation solutions and clearly recognize their benefits in terms of efficiency, cost reduction, decision-making and competitive advantage. This aligns with the advantages of AI and automation highlighted in the literature within the context of supply chain and warehouse management (Ailyn, 2024; Al Bashar, 2024; Sodiya et al., 2024).

On the other hand, the study also confirmed the challenges emphasized in the literature: high investment requirements, lack of a clear strategy, data security risks, dependence on technology and employee resistance to change (Mulla, 2022; Cooper, 2025; Li, 2024; Scott & Hoover, 2024; Hendriksen, 2023). This corresponds to hypothesis H1 – that AI and automation integration is strongly related to human resources and organizational culture.

The developed six-stage theoretical model combines these insights into a ***coherent integration framework***. The model:

- helps specify what steps a company must take, from strategy and data preparation to implementation, testing and improvement;
- highlights the social aspect – employee engagement and feedback during the evaluation stage;
- establishes the importance of continuous KPI analysis and cyclical return to earlier stages if results are not satisfactory.

Thus, the model applies the logic of an ***iterative***, ***feedback-based process management cycle***, confirming hypothesis H2. It also aligns with the staged implementation and continuous improvement concepts proposed by international authors in the field of supply chain innovation (Cooper, 2025; Teixeira et al., 2025; Delgado et al., 2025).

From a practical perspective, the model can serve as a ***guideline for wholesale companies*** planning AI and automation integration. The stepwise principle and cyclical structure allow companies to reduce the risk of integration failure, avoid chaotic or overly rapid implementation, and ensure that the use of technologies is aligned with organizational and social changes.

7. Conclusions

1. The integration of artificial intelligence and automation into wholesale companies is a complex process. Successful implementation of these technologies allows optimisation of daily operational activities in ways that reduce error rates, accelerate order processing, enable demand forecasting and support decision-making based on internal and external data, thereby ensuring a competitive advantage for the wholesale company. The main challenges identified during integration are financial, as organisations fear facing non-recoverable initial and ongoing maintenance investments; social, as there is a realistic possibility of encountering employee and management resistance to changes, most often due to lack of knowledge and competencies; and technical, as companies strive to ensure a high level of data protection.
2. The statistical data analysis revealed that automation and artificial intelligence represent an innovative solution in a growing technological market. Although, according to official 2024 Eurostat data, only 13.48 percent of all surveyed companies used AI for automation in wholesale practice (with the highest use among large companies with 250+ employees at 41.17 percent), the projected 9.39 percent industrial automation market growth for 2024–2034 indicates that wholesale companies have highly favourable conditions to integrate smart technologies into their operations. Therefore, the successful implementation of the integration process is essential.
3. To conduct a systematic and representative study, the research methodology was described in detail. Based on the analysis of scientific literature and empirical research, two hypotheses were formulated and both were confirmed. AI and automation integration into wholesale companies is closely related to human resources, which constitute a crucial part of the successful implementation process, while the implementation itself functions according to the principle of continuous feedback, the essence of which is the ongoing evaluation and improvement of technology use in the company. A quantitative research method – a questionnaire survey – was chosen to obtain standardised, reliable and comparable information from a large group of respondents, consisting of wholesale company managers, other authorised company employees and managers providing logistics services to wholesale companies.
4. The research results revealed that the benefits of AI and automation integration in wholesale companies are clearly recognised among respondents. The majority of participants fully agree with the ability of artificial intelligence to optimise warehousing, manage inventory, support data-driven decision-making, improve customer service quality, forecast product demand and increase competitive advantage. Respondents also fully agree that automation reduces operational costs, increases operational efficiency, reduces the likelihood of human error, enables more flexible responses to changes and reduces the need for human resources. Respondents prioritise AI and automation applications in specific practical operational solutions directly related to daily activities, such as logistics, transport, accounting or production process management and optimisation, as these solutions provide immediate tangible benefits. It was also determined that respondents almost unanimously agree that the initial stage of technology integration requires significant investment and that integration may potentially disrupt both the entire supply chain and daily employee operations. Therefore, a well-prepared transition plan is essential for smooth implementation. Employee resistance to

change was also identified as a key challenge that may disrupt the integration process.

5. Based on scientific literature analysis and empirical research results, a theoretical implementation model for integrating artificial intelligence and automation into wholesale companies was developed. This theoretical model consists of six different implementation stages – strategy development, data collection, implementation, testing, evaluation and continuous improvement. Each of these stages is described in detail according to the provided diagrams and is equally important; therefore, the step-by-step implementation principle is followed to ensure a consistent and cyclical process in which each stage determines the quality of subsequent stages and the overall effectiveness of the model.

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