

APPLICATION OF AUTONOMOUS MOBILE ROBOTS (AMR) IN SMART MANUFACTURING

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Purpose: The aim of this work is to analyze global and domestic market trends regarding autonomous mobile robots (AMRs) and assess their potential impact on the development of smart manufacturing.

Design/methodology/approach: The study employed a desk research approach. The data sources included statistical data from public institutions, publicly available market reports, scientific publications, and industry materials. These data were used to assess the dynamics of the AMR market, its main application areas, development forecasts in the context of smart manufacturing, and the impact of AMR implementation on the employment structure in the manufacturing sector.

Findings: It has been established that the AMR market is growing rapidly, particularly in the logistics and manufacturing sectors, constituting a significant element of the industrial transformation towards Industry 4.0. Implementing AMR can significantly increase the flexibility, efficiency, and digitization of production processes.

Research limitations/implications: The lack of access to enterprise operational data makes it impossible to assess the actual impact of AMR implementations on production efficiency.

Practical implications: The dynamic growth in the value of the AMR market and the growing number of implementations across various industry sectors indicate that this technology is becoming a key element in the transformation of production towards Industry 4.0. The results of the analysis can provide companies with guidance on planning investments in autonomous mobile systems, taking into account local labor market conditions.

Social implications: The analysis can support public policies and educational strategies to prepare workers for increasing automation, ensuring that technological innovations are balanced with labor market needs.

Originality/value: An approach combining labor market analysis with an assessment of the adoption rate of autonomous mobile robots in the manufacturing sector allows us to identify countries and sectors with high potential for AMR implementation, especially in the context of smart manufacturing, where automation can significantly increase productivity and operational efficiency.

Keywords: autonomous mobile robots, automate guided vehicles, smart manufacturing, labor market.

Category of the paper: research paper.

1. Introduction

Modern manufacturing and logistics companies are under increasing pressure to increase efficiency, flexibility and speed of response to changing market conditions (Szeszák et al., 2025). A key area that impacts an organization's ability to achieve these goals is the internal supply chain - comprising all operations related to the transport of materials, components, and products within the enterprise. Traditional methods of organizing internal logistics, based on human labor, manual task planning, and rigid transport systems (e.g., conveyor belts or AGVs guided along fixed routes), often prove insufficient in the context of the growing complexity and variability of production processes. Low flexibility, error-proneness, and limited adaptability to changing operational conditions are becoming a significant barrier to achieving full automation and optimization of internal flows (Zhang et al., 2023).

In response to these challenges, autonomous mobile robots are gaining popularity, offering a new level of quality in intralogistics. AMRs are intelligent, autonomously moving transport units capable of autonomous navigation in dynamic environments, avoiding obstacles, optimizing routes, and communicating with other production systems in real time. Unlike automated guided vehicles (AGV) systems, which follow predefined paths, AMRs use data from cameras, lidar, and other sensors to make decisions based on the current environment (Fragapane et al., 2021; Kotlars, Skribans, 2024). However, implementing AMRs is not just about their physical presence in the enterprise. A key element in effectively utilizing their potential is integration with data collection and analysis systems, which enables the implementation of advanced optimization strategies. In this context, intelligent data-driven techniques such as machine learning, optimization algorithms, and digital twins are gaining increasing importance (Dobrzańska, Dobrzański, 2025).

As a result, combining mobile robotics with data analysis technologies opens up new possibilities for the automation, adaptability, and scalability of logistics processes within an enterprise. Optimizing the internal supply chain based on these technologies can lead to shorter transport times, reduced costs, increased reliability, and improved overall production efficiency. As a result, AMRs can become the foundation of modern, integrated, and intelligent intralogistics systems that support the implementation of Industry 4.0 strategies and the smart factory concept (Oztemel, Gursev, 2020; Hercik et al., 2022). In the concept of smart manufacturing, autonomous mobile robots play a key role in streamlining production and logistics processes. Thanks to their flexibility and independent decision-making, AMRs can effectively support the transport of components, semi-finished products, and finished goods between workstations, warehouses, and assembly lines. The use of such robots contributes to increased efficiency and reduced downtime resulting from manual material handling. Furthermore, the use of AMRs allows for better utilization of production space, improved employee safety, and reduced operating costs. Their integration with production management systems (MES, ERP) enables the creation of fully automated and self-regulating work environments. As a result, AMRs are becoming one of the pillars of the digital transformation

of industry, supporting the implementation of the Industry 4.0 concept and the construction of smart factories (Jacob et al., 2023; Lackner et al., 2024; Manuguerra et al., 2023; Niermann et al., 2023; Raamets et al., 2024; Unger et al., 2018).

The implementation of autonomous mobile robots in the manufacturing sector is becoming particularly important in the context of an aging population and growing labor shortages (Bazela, 2022; Gong et al., 2023). Automating repetitive and physically demanding tasks allows not only maintaining but often increasing productivity with a limited workforce. AMRs can relieve staff of monotonous duties, allowing workers to focus on more complex tasks, while simultaneously reducing the pressure associated with a shortage of skilled labor. However, the implementation of such solutions requires appropriate preparation of the organization – including training for employees in the operation and programming of robots – which shapes a new structure of employment and competences in manufacturing enterprises.

Given the growing importance of autonomous mobile robots in modern production facilities, it is crucial to understand their development directions and the impact they may have on manufacturing processes. Dynamic technological advances and the growing demand for flexible logistics solutions are driving the AMR market to grow rapidly, both globally and domestically. The aim of this paper is to analyze global and domestic market trends for autonomous mobile robots (AMRs) and assess their potential impact on the development of smart manufacturing, productivity, and employment structure in the manufacturing sector.

2. Methods

The conducted research used the desk research method and its aim was to identify key trends in the development of the AMR market on a global scale and to assess the level of advancement of implementation of this technology in Poland and the impact on the employment structure in the manufacturing sector

The study covers the years 2020–2025 and focuses on two levels of analysis: global and national. The study analyzed the most important development directions for the professional service robots market, including AMR, its sectoral structure and growth rate, the size of the working-age population, the unemployment rate, and the number of job vacancies.

The source material included statistical data from Eurostat databases, International Federation of Robotics (IFR) reports, market reports from analytical firms, scientific publications on mobile robotics and intelligent manufacturing systems. The national section utilized data from reports from the Central Statistical Office and studies on the implementation of Industry 4.0 solutions in Poland. Data analysis was descriptive and analytical in nature. A comparative analysis was also used, allowing for a comparison of the level of robotics and automation development in Poland with other European countries.

A limitation of the study is the lack of access to enterprise operational data, which prevents the assessment of the actual impact of AMR implementations on production efficiency. Nevertheless, the analysis allowed for the formulation of reliable conclusions regarding current market trends and the potential impact of AMR technology on the development of smart manufacturing in Poland and globally.

3. Results

This chapter presents the scale of service robot use, including AMRs, identifies market trends, and compares Poland's position in the European and global markets. The impact of AMR implementation on the employment structure in the manufacturing sector is also determined. The analysis was conducted according to the IFR robot classification. According to this classification, AMRs are professional service robots and constitute a key element of the smart factory, automating material transport and integrating with production systems. In the context of the smart factory, their role involves autonomous material transport, integration with production systems, and supporting process flexibility and optimization. Global sales of professional service robots increased by 9% in 2024. According to IFR, the number of professional service robots sold in 2024 reached 199,000 units. The five most popular application groups for professional service robots (excluding medical robots) in terms of unit sales in 2024 were transportation and logistics, hospitality, professional cleaning, agriculture, and search and rescue, security (IFR, 2025). Mobile robots, including AMRs, are well-known in the transport and logistics sector, which encompasses the use of mobile robots in internal transport and logistics processes within manufacturing enterprises (transporting raw materials, semi-finished products, and finished products between plant locations, warehousing, and picking in production halls). In 2024, 14% more units were sold in this sector compared to 2023 (Figure 1).

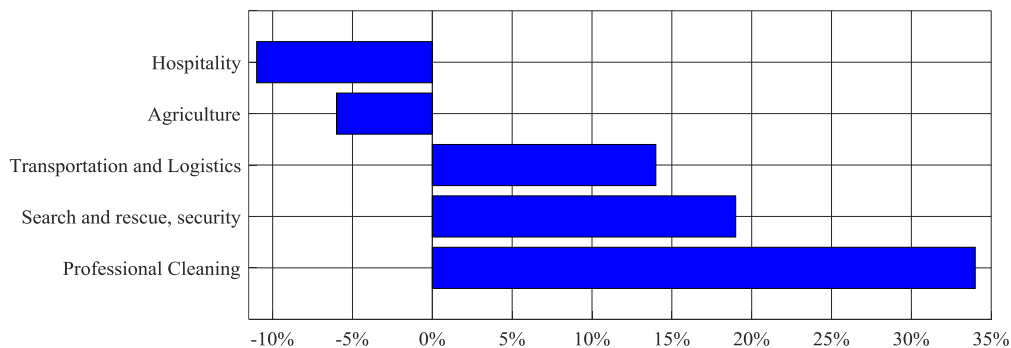


Figure 1. Growth rates of sales of professional service robots in 2024 compared to 2023, broken down by sector.

Source: International Federation of Robotics – 06.05.2025.

Robots designed for transportation and logistics applications accounted for the largest number of robots sold among professional service robots in 2024 (Figure 2). This is also reflected in the number of suppliers offering this application group. IFR provides information on 333 companies worldwide supplying various types of logistics robots.

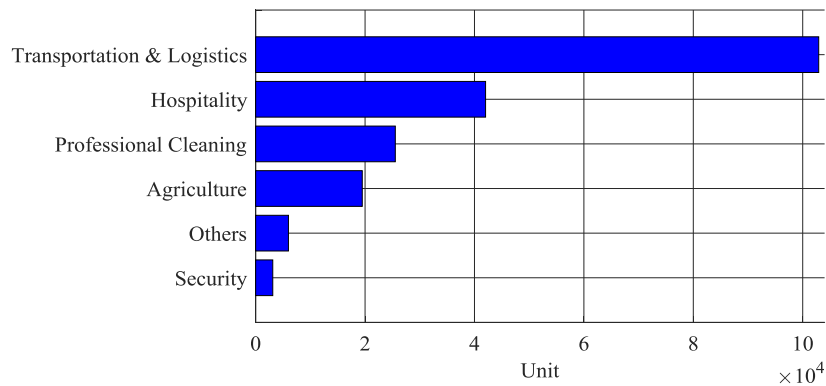


Figure 2. The number of professional service robots sold in each sector and their percentage share.

Source: International Federation of Robotics – 06.05.2025.

Eurostat data allows us to assess the degree of actual implementation of service robots, indicating the percentage of enterprises that use this type of technology in production and logistics processes, which is a practical reflection of trends related to the automation and digitalization of industry. The data presented in Figure 3 shows the percentage of enterprises (with more than 10 employees) using professional service robots.

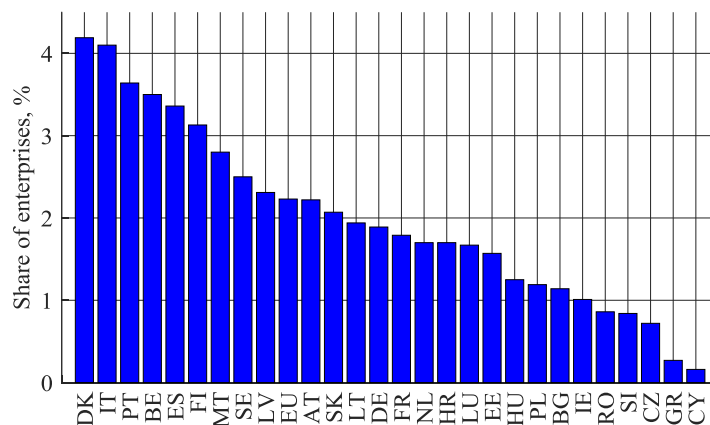


Figure 3. Share of enterprises using service robots in 2022 (enterprises ≥ 10 employees, excluding financial sector).

Source: own study based on data from the Eurostat database - 20.09.2025.

The prevalence of service robots is highest in Danish and Italian companies, at over 4%. Portuguese, Belgian, Spanish, and Finnish companies are second, with a level of over 3%. The EU average is 2.23%, with a maximum of 4.19% in Danish companies and a lowest of 0.16% in Cyprus. Polish companies using professional service robots accounted for 1.19% in 2022. Figure 4 presents the percentage of companies using professional service robots by employee number.

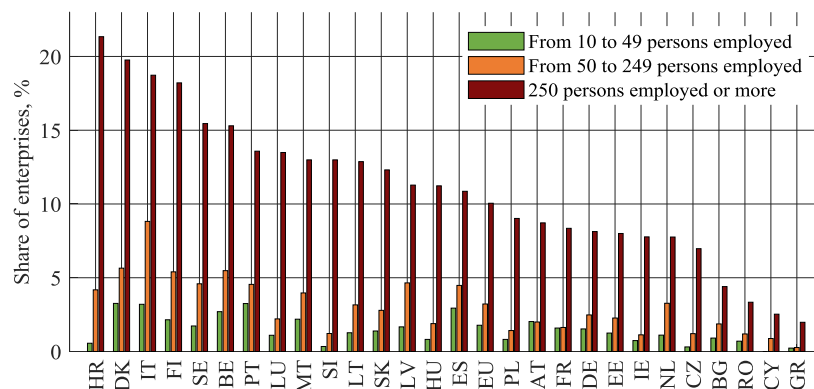


Figure 4. Share of enterprises using service robots by size of enterprises in 2022.

Source: own study based on data from the Eurostat database - 20.09.2025.

The graph shows that larger companies are more likely to use service robots in every country. Medium-sized and large enterprises are generally more likely to implement new technologies because they have easier access to investment capital and can utilize the necessary skills. In the EU, the average for small enterprises is 1.78%, for medium-sized enterprises 3.22%, and for large enterprises 10.05%.

Polish companies using professional service robots accounted for 1.19% of the total in 2022. This share was 0.8% for small companies, 1.4% for medium-sized companies, and 9% for large companies. Considering the type of business, professional service robots were most frequently used in businesses related to the repair and maintenance of computers and communications equipment (2.7%). Next in line are transportation and storage (1.6%) and manufacturing (1.6%). A detailed breakdown by business type is presented in Figure 5.

Differences in the adoption of service robots across companies of different sizes and industries can be explained by structural factors. The higher adoption of robots in large enterprises stems from greater technological potential and the availability of financial resources to invest in automation. In small companies, financial constraints and the scale of operations limit the ability to implement new technologies. However, variations across industries reflect the specific nature of processes – in sectors such as computer repair and maintenance, service robots are used for repetitive and precise tasks, while in other areas, their use is more difficult or less profitable. Considering these conditions allows for a better understanding of the structure of service robot adoption in Poland and indicates areas where technological or training support could enhance their use.

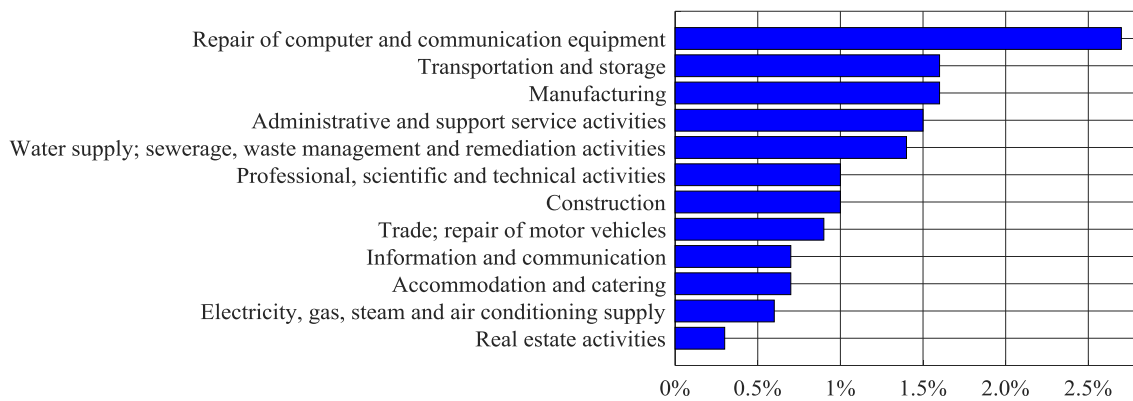


Figure 5. Enterprises in Poland using service robots in 2022.

Source: own study based on data from the Local Data Bank database – 16.06.2025.

Autonomous mobile robots constitute a significant part of the service robot market. Thanks to their ability to move independently and integrate with production systems, they are becoming a key element of modern industrial solutions. In recent years, the global mobile robot market has been experiencing dynamic growth, which is reflected in the growing number of units sold. In 2022, approximately 121,000 AGV and AMR robots were sold worldwide. Just a year later, in 2023, this number increased to 164,000, with AMRs accounting for more than half. Forecasts for the coming years are even more optimistic. By the end of 2025, annual sales are expected to exceed 250,000 units (Zrobotyzowany.pl, 2025).

According to data published by Statzon, presented in Figure 6, the global autonomous mobile robot market value in 2023 was USD 1.4 billion, which represents a 9% increase compared to the previous year (Statzon, 2025).

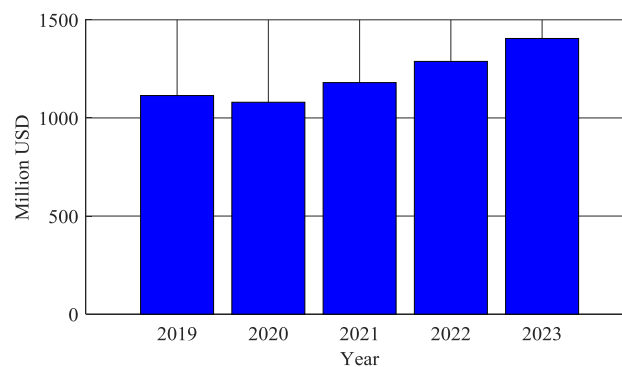


Figure 6. Global Autonomous Mobile Robot Market.

Source: Statzon – 15.06.2025.

The mobile robotics market is growing steadily. North America stands out in particular for the use of AMRs, clearly outperforming other regions. Market data analysis indicates that North America maintains its leading position in the global AMR market. The region's dominance stems from several factors: advanced technology and innovation, including the presence of market leaders, startups, and leading research centers; extensive logistics and warehousing infrastructure, including large distribution centers and developed e-commerce networks;

economic drivers for automation, such as high labor costs, pressure for process efficiency, and growing online ordering; and public acceptance and willingness to implement modern technologies, which facilitate the rapid adoption of robots in operational practice. These results underscore that North America remains a key market for the testing and implementation of AMRs, serving as a model for other regions, including Europe and Asia. The regional share of the global AMR market in 2023 is presented in Figure 7. The data shows that North America remains the clear leader, accounting for 35% of the global market. Asia-Pacific is second with a 30% share, while Europe accounted for 21% of the market value. Other regions of the world accounted for 14%. This structure reflects global trends and regions that have invested in the transformation and automation of intralogistics processes in recent years (Statzon, 2025).

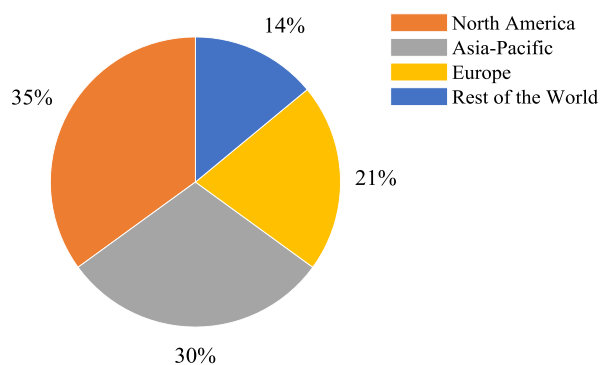


Figure 7. Regional share in the global autonomous mobile robots market.

Source: Statzon – 15.06.2025.

AMR robot technology is considered advanced, but its implementation still faces a number of barriers resulting from limited customer awareness, lack of standardization, lack of knowledge, and integration problems with existing infrastructure, which still result in low market penetration of this technology. It's worth noting that while the pandemic significantly increased interest in in-plant automation, accelerating solution testing, this hasn't contributed to a rapid and widespread increase in wider-scale implementations. Implementing AMR robots often requires close collaboration between multiple units within the organization, multi-stage planning, complex knowledge, and appropriate preparation of the technical infrastructure, particularly in terms of wireless connectivity, which is crucial for stable robot operation in dynamic industrial environments.

The degree of implementation of AMR solutions depends largely on the specific industry. The largest recipients of these technologies remain sectors such as logistics, the food industry, and healthcare. However, in many industries, insufficient awareness of the benefits, implementation expertise, and adequate budget remain barriers, significantly slowing down the implementation process of these solutions. An interesting solution to budgetary issues that lowers the entry threshold is the development of the RaaS (Robotics as a Service) model, which enables the use of robots via subscription. This approach increases the operational flexibility of enterprises, allowing them to test various automation scenarios without the need for high

upfront capital expenditures. As a result, the RaaS model is becoming increasingly popular, especially among smaller companies (IFR, 2025).

In 2023, the logistics industry was the most significant contributor to the global AMR market, accounting for 24% of the total market share. This high share is due to the rapid growth of the warehousing sector, e-commerce, and the expansion of distribution centers, where AMRs significantly increase efficiency and reduce operating costs. This was followed by the food industry (14%), healthcare (11%), and the fast-moving consumer goods (FMCG) sector (11%). All these dominant sectors are characterized by high requirements for the fast and hygienic transport of finished products. Additionally, sectors such as pharmaceuticals, electronics, and automotive also had significant shares. This structure demonstrates that AMRs are becoming a universally applicable technology, gradually entering a broader range of industries. Figure 8 shows the percentage share of these sectors in the global AGV and AMR robot market (Statzon, 2025).

In the European context, Poland represents a small segment of the AMR market, but estimates indicate a growing interest in internal transport automation. Although Poland's share in the European market is limited, domestic companies are gradually implementing autonomous mobile robots, which is consistent with the global trend of increasing adoption of this technology. Estimates indicate that the number of autonomous mobile robot installations in Polish companies represents only 2–3% of the overall European market. Despite their relatively small scale, clear signs of growing adoption of these technologies are observed, especially in warehouses, logistics centers, and the manufacturing sector, where internal transport automation is becoming increasingly economically attractive. The growing interest in AMRs in Poland is consistent with the global trend of increasing automation of logistics and production processes, indicating that the domestic market may accelerate the pace of autonomous mobile robot implementation in the coming years.

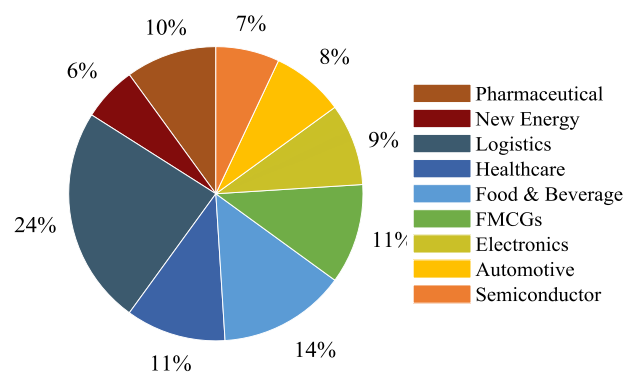


Figure 8. Types and market shares of autonomous mobile robots.

Source: Statzon – 15.06.2025.

The global market for autonomous mobile robots is growing at an extremely dynamic pace, with a projected average annual growth rate (CAGR) of approximately 22.3% between 2025 and 2034 (Precedence Research, 2025). This rapid growth is driven by the growing importance

of automation in the data-driven economy, the increasing demand for flexible logistics solutions, and the intensifying global demographic challenges. Europe, one of the leaders in industrial transformation, is also seeing rapid development of the mobile robot market. The average growth rate between 2022 and 2032 is estimated at approximately 18-20% (ASD Reports, 2025; OpenPR, 2025). This growth is fueled by both the ongoing digitization of industry and socioeconomic factors. Consequently, process automation, including the implementation of AMRs, is becoming a way for European companies to maintain business continuity, cost stability, and a high level of service quality. Analysis of the demographic structure of the working-age population (15–64 years) in EU countries and Poland shows a clear downward trend in recent years. In Poland, the percentage of the working-age population decreased from 70.1% in 2014 to 64.4% in 2024. Similar trends are observed in most EU member states, although at different rates (Table 1).

Table 1.

Working-age population in European Union countries (%)

	AT	BE	BG	CY	CZ	DE	DK	EE	ES	EU	FI	FR	GR	HR
2014	67.4	65.2	66.2	69.9	67.6	66.0	64.5	65.8	66.7	66.0	64.2	63.4	64.9	66.7
2024	65.8	63.8	62.1	67.0	63.6	63.6	63.6	63.5	66.4	63.8	61.8	61.6	63.6	62.9

	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK
2014	68.1	65.9	64.6	67.1	69.1	66.2	67.8	65.7	70.1	65.4	68.0	63.5	67.9	71.1
2024	64.9	65.6	63.5	65.1	69.2	63.0	69.3	64.4	64.4	63.1	64.1	62.3	63.5	65.7

Source: own study based on data from the Eurostat database - 20.09.2025.

Changes in the demographic structure of the working-age population in Poland and the European Union have a significant impact on the functioning of the labor market, as reflected in the unemployment rate and job vacancy rates. A comparison of data for the manufacturing, transportation, and warehousing sectors in Poland and the European Union in 2014 and 2024 indicates a significant shift in the labor market structure (Table 2, Table 3). In 2014, the average unemployment rate in these sectors in the EU was 10.9%, with a job vacancy rate of 1.0%. In Poland, the corresponding figures were 9.0% and 0.6%, respectively, reflecting low labor market absorption, limited demand for workers, and relatively low investment activity in industry and logistics. In 2024, the situation changed significantly—average unemployment in the manufacturing, transportation, and warehousing sectors in the EU fell to 5.9%, while the share of job vacancies more than doubled, to 2.1%. In Poland, unemployment was even lower, at 2.9%, with a job vacancy rate of 1.0%. These data clearly indicate a transition from a market characterized by a labor surplus to a market with a clear labor shortage.

Table 2.*Unemployment rate in European Union countries (%)*

	AT	BE	BG	CY	CZ	DE	DK	EE	ES	EU	FI	FR	GR	HR
2014	5.7	8.6	11.5	16.1	6.1	5.0	7.0	7.3	24.5	10.9	8.6	10.3	26.6	17.3
2024	5.2	5.7	4.2	4.9	2.6	3.4	6.2	7.6	11.4	5.9	8.4	7.4	10.1	5.1

	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK
2014	7.7	11.9	12.7	10.7	5.9	10.9	5.7	7.4	9.0	14.1	6.8	8.0	9.8	13.2
2024	4.5	4.3	6.5	7.1	6.4	6.9	3.1	3.7	2.9	6.4	5.5	8.4	3.7	5.4

Source: own study based on data from the Eurostat database - 20.09.2025.

Table 3.*Job vacancy rate in European Union countries (%)*

	AT	BE	BG	CY	CZ	DE	DK	EE	ES	EU	FI	FR	GR	HR
2014	1.4	1.6	0.5	0.6	1.1	1.6	1.2	1.2	0.3	1.0	1.2	0.7	0.9	0.6
2024	3.9	4.1	0.6	2.6	3.8	2.6	2.3	0.9	0.6	2.1	1.2	2.3	2.0	1.4

	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK
2014	1.4	0.6	N/A	1.1	0.4	1.8	N/A	1.3	0.6	0.4	0.8	1.2	1.4	0.7
2024	1.8	1.0	2.0	1.9	1.0	2.5	3.0	5.2	1.0	1.1	0.7	2.0	2.6	0.9

Source: own study based on data from the Eurostat database - 20.09.2025.

In the context of these demographic and labor market changes, it is worth examining the role of automation and robotization in enterprises. Analysis of data for EU countries indicates that the development of automation is the result of a complex interplay of demographic factors, the labor market, and investment strategies, and these relationships are not direct. Most countries observed a decline in the working-age population between 2014 and 2024, which theoretically increases the pressure for automation. For example, in Poland, the working-age population decreased from 70.1% to 64.4%, while the share of robots in enterprises reached 1.19% in 2022. In this context, low unemployment (2.9%) and moderate job vacancies (1.0%) in 2024 suggest that automation is complementing the limited labor supply. It is worth noting that the data comes from different periods – the robot utilization rate is from 2022, while the unemployment and job vacancy rates are from 2024. This comparison is justified because decisions on investments in automation respond to earlier demographic changes and labor market trends, and the process of implementing the technology takes time, so a direct comparison of indicators from the same year might not reflect the actual relationships.

In Germany (a decline from 66% to 63.6% of the working-age population) and Italy (64.6% to 63.5%), the share of robots is significantly higher, despite moderate unemployment and available job vacancies. This demonstrates that, in addition to labor supply, the development of robotization is shaped by capital availability, prior technological investments, and corporate policies. There are also significant cases where demographics and labor market indicators do not fully explain the level of automation. Spain, with a nearly unchanged working-age population (66.7% in 2014 and 66.4% in 2024), high unemployment (11.35%), and low job

vacancies (0.1%), maintains a relatively high share of robots (3.36%), demonstrating that technology investments can grow regardless of short-term labor supply. Similarly, Portugal, Finland, and Luxembourg indicate that structural, economic, and strategic factors are as important as demographics and the labor market.

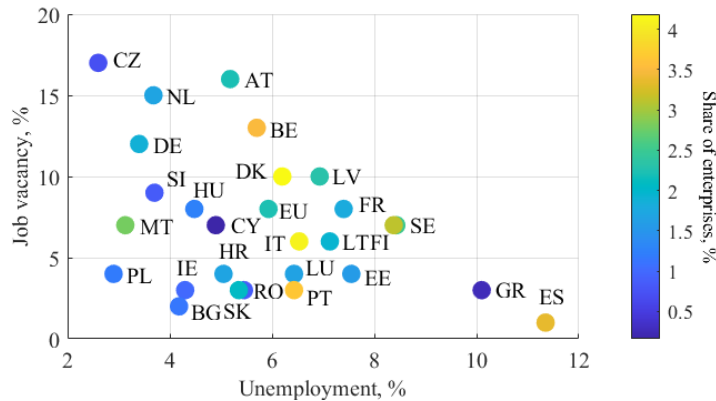


Figure 9. The relationship between the share of robots in enterprises (2022), the unemployment rate and the job vacancy rate (2024) in EU countries.

Source: own study based on data from the Eurostat database - 20.09.2025.

The conclusions from the analysis of the graph, which presents the relationships between unemployment, vacancies and the share of robots in enterprises, show general correlations: moderate labor market indicators may support automation, but they are not its only determinant (fig. 9). These trends confirm that robotization is a multifactorial process, in which demographics and the labor market influence investment decisions, but their impact is modulated by access to capital, company strategy, and national technological policies.

4. Discussion

Analysis of data on the use of service robots in manufacturing companies in EU countries shows that the development of automation is a multifactorial process. It is influenced by both demographic factors, such as the declining working-age population, and the labor market situation, including unemployment and job vacancy rates. Demographic changes, including an aging population and the growing share of older workers, favor the adoption of robots and automation technologies, as a reduced supply of working-age labor increases the pressure to replace human labor with technological capital. This relationship has been confirmed in the scientific literature: both in theoretical and empirical studies demonstrating the impact of population aging on automation (Acemoglu, Restrepo, 2022), quantitative models analyzing the mechanisms of this process (Jacobs, Heylen, 2024), and in macroeconomic perspectives, which show that population aging favors the increased use of robots and automation (Stähler, 2021). Research indicates that a limited supply of working-age labor can favor increased

investment in robotization, although the pace of technology implementation also depends on many other conditions.

There is also noticeable variation between countries: in some countries, despite moderate unemployment and labor availability, the share of robots is high, suggesting the role of companies' investment strategies, capital availability, and prior experience with technology. In other cases—such as Spain—high levels of automation occur despite a stable working-age population and high unemployment, demonstrating that decisions to implement robots may be driven by other factors, such as operational efficiency, the need to improve service quality, or improved competitiveness.

Differences in the pace of robot adoption across EU countries provide a better understanding of the potential barriers and determinants of autonomous mobile robot (AMR) adoption in industry. The high share of robots in countries with a limited working-age population suggests that investment costs and insufficient digital infrastructure may be the main constraints to implementation. In countries where the number of manufacturing vacancies remains high and the pace of robot adoption is moderate, barriers are organizational in nature, including the need to reorganize production processes and a shortage of qualified personnel to operate AMR systems. Consequently, the market growth rate and the degree of robot adoption in Europe are driven by a combination of financial factors, employment structure, availability of skills, and companies' ability to integrate new technologies. Comparing robot adoption rates across countries and sectors can indirectly indicate the relative importance of individual barriers. However, these conclusions are qualitative in nature and require further quantitative research for accurate verification.

In this context, the concept of smart factories is gaining increasing importance, where service robots, including autonomous mobile robots, are an integral part of integrated production and logistics processes. In smart factories, automation is not limited to individual machines – it encompasses comprehensive material flow management, performance monitoring, and adaptation to changing working conditions, allowing companies to better respond to demographic changes and labor supply constraints.

Overall, the data presented confirm that automation in the manufacturing sector, particularly in the form of service robots such as AMRs, does not follow demographic changes or labor market fluctuations linearly. It is the result of a complex interaction of structural, economic, and technological factors. These trends suggest that policies supporting automation development should consider not only labor shortages but also investments in technological infrastructure, employee training, and company adaptation strategies.

5. Summary

Autonomous mobile robots are paving a new direction in industrial transformation, integrating mobile automation with smart factory concepts. Their growing importance stems not only from the desire to streamline logistics processes but also from the need for companies to adapt to the changing demographic and market environment, including the shortage of skilled labor. The introduction of AMRs in manufacturing plants creates the opportunity to shape flexible and resilient production systems in which automation and human skills coexist, creating synergistic effects in terms of efficiency, quality, and process innovation. Furthermore, the development of mobile automation points to new organizational and strategic perspectives in the industrial sector – from the thoughtful allocation of human resources to the implementation of more complex, intelligent production management systems. AMRs not only support current operational needs but also shape future factory operating models, where the role of humans is shifting toward tasks requiring creativity, analysis, and decision-making, rather than merely repetitive work. In the long term, the development of the AMR market can contribute to increased competitiveness of companies, reducing staffing pressures, and introducing innovative production standards. An industry that effectively integrates autonomous technologies with qualified staff gains an advantage in adapting to dynamic market changes and creates the foundations for sustainable production development in the conditions of global digitalization and automation.

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