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THE USE OF ARTIFICIAL INTELLIGENCE (AI) BY BUSINESSES AS MEASURED BY POLISH PUBLIC STATISTICAL DATA

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Purpose: This study aims to conduct a comprehensive analysis of the level of AI adoption by Polish businesses in 2021, 2023 and 2024 based on public statistical surveys. This article focuses on the scale, structure, and conditions of the use of artificial intelligence technology in Polish businesses.
Design/methodology/approach: The analysis is based on data from the study conducted by the Central Statistical Office on the use of information and communication technologies in businesses. A quantitative approach based on secondary data analysis (desk research), supplemented by a review of the literature on the subject. The study investigated the overall percentage of companies using AI, as well as the typology of the technologies implemented.
Findings: Empirical analysis reveals apparent disparities in the use of artificial intelligence across Polish companies, both by region and by industry. AI technologies are much more often implemented in areas with highly developed technological and educational facilities. Industries related to digital technologies, particularly the information and communication sector, show the highest activity in AI. Their advantage lies in the great potential for process automation, the use of large data sets, and the availability of specialised personnel. Variation is also apparent at the level of ownership. Businesses with foreign capital implement AI more often than those funded domestically. The technologies used primarily include automatic learning systems, image analysis, and natural language processing. The conclusions drawn from the study are unambiguous. Despite the growing importance of AI in the economy, its use by companies in Poland remains limited and uneven. Such a situation may deepen the existing developmental divisions, which is why it is essential to take systemic action. Investments in education, the dissemination of knowledge about the possibilities of using AI, and the strengthening of innovation ecosystems should play a key role.
Research limitations/implications: The analysis is based solely on data from 2021, 2023 and 2024. The lack of data for 2022 limits the ability to accurately capture the dynamics of change.
Originality/value: The study should be seen as a contribution to the scientific discussion on the development of artificial intelligence and the level of its adaptation by enterprises in Poland.
Keywords: artificial intelligence, enterprises, public statistics.
Category of the paper: research paper.

1. Introduction

Artificial intelligence is rapidly advancing as a leading force in digital transformation, reshaping how social and economic structures operate. Despite the imperfections which still exist, the technology continues to replace humans. It is increasingly responsible for the technological transformation of businesses. In fact, artificial intelligence is a requirement of the modern world and a condition for the survival of companies (Bielińska-Dusza, 2022, p. 193).

AI is used by companies, among others, in production (automation of tasks, improvement of quality control, optimisation of production processes), in retail trade (personalisation of consumer purchasing experiences, the use of recommendation engines, automation of customer service) or in the financial industry (detecting fraud, risk management, supporting investment decisions). The implementation of such solutions reduces costs, creates conditions for innovation, improves customer satisfaction and loyalty, increases security, profitability and, in turn, the competitiveness of enterprises (Polish Agency for Enterprise Development, 2023, p. 46).

This study aims to conduct a comprehensive analysis of AI adoption levels among Polish businesses in 2021, 2023, and 2024, based on public statistical surveys. In particular, the study focuses on identifying the scale, structure and conditions for the use of AI, taking into account regional variables (by Voivodeships), sectoral, business size and ownership structure. In addition, the analysis covers the dominant types of AI solutions and the barriers to their implementation identified by companies.

2. Genesis and methods of defining the concept of artificial intelligence

When considering the use of artificial intelligence by companies in Poland, it is essential to have prior knowledge of its background and architecture. The history of artificial intelligence has its origins in human attempts to understand the nature of the mind and its ability to reproduce it in artificial systems. The breakthrough occurred with the publication of Alan Turing's 1950 article “Computing Machinery and Intelligence”. He introduced the Turing Test to answer the question: *Can machines think?* Instead of trying to define thinking itself, Turing proposed a thought experiment to assess the machine’s ability to manifest intelligent behaviours indistinguishable from those of human beings (Małyska, 2025, p. 140). Later in 1956, the term *artificial intelligence* (AI[1]) was coined by John McCarthy, and it is now one of the key concepts in debates over technological development. The first works on artificial intelligence focused on

[1] Acronym for *artificial intelligence*. Within the article, it is used interchangeably with the full expression ‘artificial intelligence.’

using cognitive models to simulate and explain human ability to process information, using *'logical'* systems which implement reasoning based on common sense and expert rationale, as well as on robots which perceive the environment and interact with it. The works were funded by the *Defence Advanced Research Projects Agency* (DARPA) and the *Office of Naval Research* (ONR) in the USA. Wide-scale research on AI began in the early 1960s of the 20th century. It has led to theoretical progress and the development of practical technologies to address information processing in the military, science, medicine, and industry (Waltz, 1996). Due to technological constraints, AI has been depicted mainly in pop culture narratives for decades before it found practical application. Today's AI penetrates virtually all areas of social life, ranging from science and humanities to legal systems (Czapska, 2018, p. 15). The reason why AI has gained such popularity in recent years lies in the availability of large amounts of data, advanced algorithms, and increasing computing and data storage capabilities. Figure 1 depicts the historical timeline of artificial intelligence.

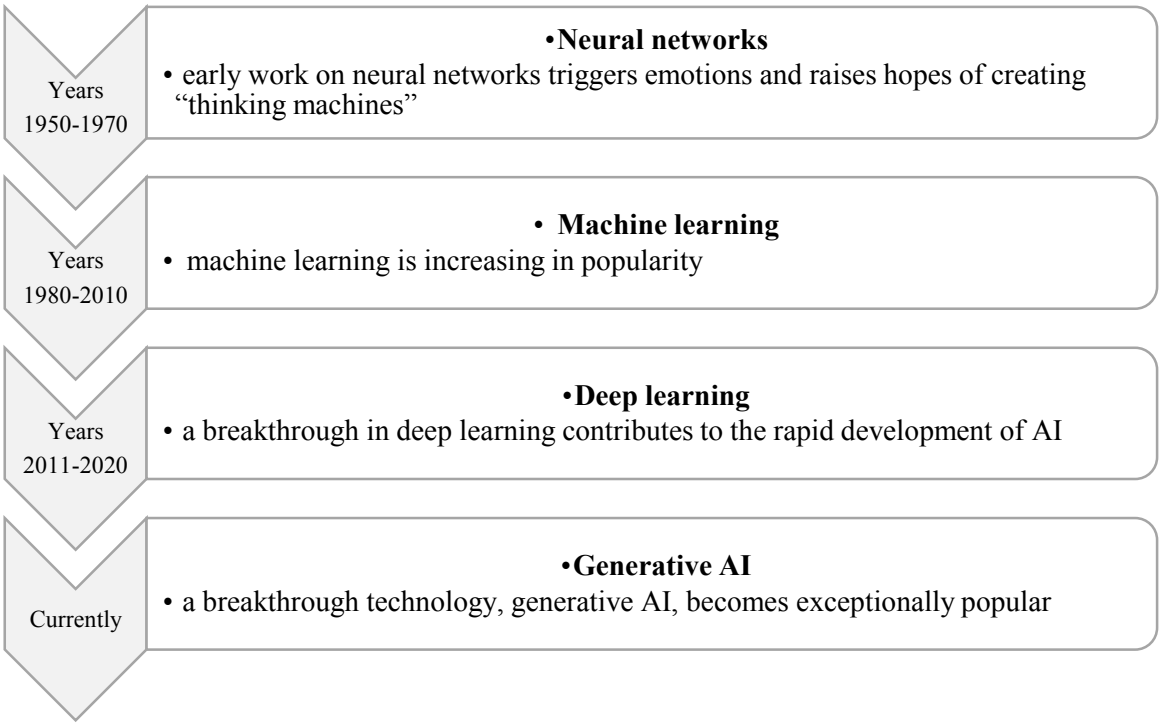

Figure 1. The historical timeline of artificial intelligence.

Source: own development based on SAS Institute Inc., 2025.

The literature contains dozens of attempts to define the concept of artificial intelligence. This is due to historical developments and to the lack of consensus on the scope and subject matter of the idea (Flasiński, 2024, p. 325). Therefore, it seems reasonable to learn about the essence of the concept. The selected definitions of artificial intelligence are depicted in Table 1.

Table 1.
Selected definitions of artificial intelligence

Source	Definition of artificial intelligence
(Nilsson, 2010, p. 13)	Artificial intelligence is the process of making machines intelligent, and intelligence is a feature that enables an object to function predictably and adequately in its environment.
(Stone et al., 2016, p. 4)	Artificial Intelligence (AI) is a science and a set of computing technologies that, however, operate completely differently from how humans use their nervous systems and bodies to feel, learn, reason, and take action.
(OECD, 2019, p. 7)	An artificial intelligence system is a machine-based system capable of formulating forecasts and recommendations, or making decisions, that affect a real or virtual environment for a specific set of objectives defined by humans.
(Statistics Sweden, 2019)	Artificial intelligence refers to systems that demonstrate intelligent behaviour by analysing their environment and taking action with a certain degree of autonomy to achieve specific objectives. AI-based systems can be implemented either as software or built into hardware.
(European Commission, 2019, p. 2)	Artificial intelligence allows machines to learn and make decisions without human involvement. Artificial intelligence is not an end in and of itself, but rather a tool that must serve humans to improve human well-being.
(Warszycki, 2019, p. 115)	Artificial intelligence is a scientific field that brings together fields, methods, tools, and techniques to create and develop a complete computer program that accurately reflects the model of human functioning and mind.
(U.S. Congress, 2020, p. 1137)	An artificial intelligence system is a machine-based system capable of formulating forecasts and recommendations, or making decisions, that affect a real or virtual environment for a specific set of objectives defined by humans. Artificial intelligence systems use machine and human input data for: (A) perceiving real and virtual environments; (B) transforming these insights into models through automated analysis; and (C) using model reasoning to formulate options for information or actions.
(Zalewski, 2020, p. 3)	Artificial intelligence is a system that enables the execution of tasks that require learning and that takes into account new circumstances when solving a specific issue; it may act autonomously and interact with the environment to varying degrees, depending on its configuration.
(Oracle, 2021)	Artificial intelligence is a term that describes applications that perform complex tasks, such as online communication with customers or chess games that previously required human participation.
(Polish Agency for Enterprise Development, 2023, p. 5)	Artificial intelligence is a sub-discipline of computer science which develops information systems which can learn and act autonomously.
(Sheikh et al., 2023, p. 15)	Artificial intelligence is the simulation of human intelligence by computers.
(Bar, 2024, p. 21)	AI, or AI systems, are computer software operating at different levels of autonomy. Having clear or implied objectives at its disposal, it can generate output data in the form of forecasts, recommendations, or decisions that affect the physical or virtual environment.
(Flasiński, 2024, p. 325)	1. Artificial intelligence is a common area of computer science and robotics, where research is carried out on developing systems designed to perform activities requiring human intelligence. 2. Artificial intelligence means a feature of artificial systems which allows them to perform actions which require human intelligence.
(McKinsey & Company, 2024)	Artificial intelligence is the ability of a machine to perform cognitive functions typically associated with the human mind.
(National Statistical Institute of the Republic of Bulgaria, 2024)	Artificial intelligence refers to systems using technologies, such as text analysis, image and speech recognition, natural language generation, machine learning, deep learning, etc., for the collection and/or use of data for the purposes of making predictions, recommendations or for decision-making, at varying levels of autonomy to suggest the best actions to be taken to achieve specific objectives.

Cont. table 1.

(NASA, 2024)	Artificial intelligence refers to computer systems that can perform complex tasks that are usually performed by human reasoning, decision-making, and creativity.
(European Parliament and Council of the EU, 2024, p. 46)	Artificial intelligence system is a machine system which is designed to operate at different levels of autonomy after it has been implemented, and which may demonstrate the ability to adapt after its implementation, and which infers on how to generate results based on the obtained input data, such as predictions, content, recommendations or decisions which may affect the physical or virtual environment to achieve clear or implied purposes.
(Statistics Austria, 2024)	Artificial intelligence refers to technologies which mimic intelligent behaviour and have a certain degree of autonomy in performing specific tasks.
(The National Conference of State Legislatures, 2024)	Artificial intelligence involves the use of computer systems to perform tasks which usually require human intelligence, such as learning and decision-making. It has the potential to transform the economy and the way people live and work.
(Central Statistical Office, 2025)	Artificial intelligence refers to systems that use technologies such as text exploration, machine learning, or deep learning to collect or use data to predict, recommend, or make decisions at different levels of autonomy.
(Central Statistical Office, 2025)	Artificial intelligence includes software systems that use technologies such as text mining, computer vision, speech recognition, natural language generation, machine learning, deep learning, and data collection or processing for the purpose of making predictions, recommendations, or decisions. They may be part of computer software or be built into devices.
(Central Statistical Office, Ireland, 2025)	Artificial intelligence refers to systems that use technologies such as text analysis, machine learning, or deep learning to collect or use data to predict, recommend, or make decisions at varying levels of autonomy.
(Information Commissioner's Office, 2025)	Artificial intelligence is a set of technologies based on algorithms that solve complex tasks and perform functions previously performed by humans.
(International Organization for Standardization, 2025)	Artificial intelligence is an area of computer science that creates systems and software capable of performing tasks considered exclusively human.
(SAS Institute Inc., 2025)	Artificial intelligence enables machines to learn from experience, adapt to new data, and perform human-specific tasks.
(Statistics Netherlands, 2025)	Artificial intelligence describes machine-based systems that can generate output data for specific purposes based on provided input data. These systems are capable of developing forecasts, giving advice, or making decisions that affect the physical or virtual environment to a specific degree of autonomy.

Source: own elaboration based on the publication above.

A review of the definition shows that the vast majority of them create a comprehensive terminological structure. They primarily relate to machine-based systems that perform tasks that require human skills. The remaining companies constitute the minority that emphasise AI as a scientific field, creating the conditions for equipping artificial machines with features that allow them to perform tasks typically requiring human intelligence. Regardless of the differences in wording, all the definitions relate to activities that create added value by saving time and reducing human workload.

It should be stressed that AI is interdisciplinary. Artificial intelligence is not pure science (explaining section), and it is merely the basis of an engineering discipline (emulating section). Both matters are included in the statement that artificial intelligence aims to understand intelligence for practical applications (Kwaśnicka, 2000, p. 15). Artificial intelligence relates to several scientific disciplines. It crosses issues in computer science, statistics, mathematics, humanities, philosophy, social sciences, and management (Karski, 2022, p. 206). Research on artificial intelligence covers a wide range of methods and techniques from various scientific

areas. The most critical areas of research are data exploration, algorithmics, machine learning, mechatronics, cognitive science, logic, statistics, and knowledge management (Goczyła, 2018, p. 13).

3. Key areas of artificial intelligence

The following main sub-disciplines may be distinguished within the research and technological approaches developed in the area of artificial intelligence (Bar, 2024, p. 21; Piwowar et al., 2023, pp. 6-7; Warszycki, 2019, p. 115):

- Machine learning focuses on developing algorithms which are capable of learning based on data. Machine learning algorithms are usually trained on large datasets and later used to make predictions and support decision-making. The following areas may be distinguished within ML: deep learning and reinforcement learning. Deep learning involves teaching computers to think and learn like the human brain. It is used to recognise images, process natural language, recognise speech, or translate languages. Reinforcement learning is a method in which an agent (e.g., a robot or software) learns to make decisions through interaction with its environment.
- Natural Language Processing (NLP) focuses on understanding and generating human language. NLP algorithms are used for speech recognition, machine translation and summarising text.
- Computer vision focuses on understanding and interpreting images. Computer vision algorithms are used, among others, in autonomous vehicles, facial recognition and medical image analysis.
- Neural Networks, i.e. computing models which are inspired by the structure of the brain and try to mimic its mode of action.
- Problem solving and reasoning concerns the application of computer systems and algorithms capable of performing tasks which would require human intelligence. Algorithms enable data analysis, pattern recognition, experience-based learning, decision-making, and the generation of new solutions.

The literature contains numerous descriptions of AI typology. One of the most frequently cited and widely used is the division based on functional criterion (Table 2). The functional criterion is based on AI systems' ability to perform specific tasks.

Table 2.
AI typology by functional criterion

Artificial intelligence	
General functionality	Specific functionality
Machine Learning	Deep Learning, Supervised Learning, Unsupervised Learning
Natural Language Processing	Classification, Machine Translation, Answering Questions, Text Generation, Content Extraction
Planning	Not identified
Image Processing	Image Recognition, Machine Vision
Speech Processing	Speech-to-Text, Processing, Text-to-Speech processing
Robotics	Not identified
Expert Systems	Not identified

Source: own elaboration based on IAB Polska 2024, p. 13; Karski 2022, p. 208.

In addition to the aforementioned sub-sections of utilitarian AI, attention should be paid to technologies which automate processes or assist decision-making. *Robotic Process Automation* (RPA) is an example of such a solution. This software simulates human activities on the computer, i.e. clicking, typing and navigating systems to perform tasks automatically. Artificial intelligence interprets, while RPA performs precise, repeatable actions in various systems. The task of RPA bots is to execute a set of instructions. They do not analyse data or make decisions. RPA and AI are automation technologies, but they operate under different principles. RPA executes instructions while AI generates output data based on context (Kargwal, 2025).

4. Research methods

The dynamic development of technology, including artificial intelligence, has a significant impact on how modern companies operate. The increasing availability of AI-based solutions offers new opportunities to automate processes, optimise costs, analyse data, and develop innovative business strategies and models. Their implementation is not only an element of increased competitiveness but also a response to changing market conditions and growing customer expectations. Empirical data that allow for assessing the actual level of implementation of artificial intelligence in companies in Poland gain particular importance. They provide the basis for analysing the directions of technological transformation, the scale of AI applications and the willingness of companies to adopt such solutions.

The analysis is based on statistical data published by the Central Statistical Office. Since 2004, it has been publishing the results of regular surveys on the use of information and communication technologies in enterprises, which are available online[2]. Since 2021, these surveys have included a module dedicated to the application of artificial intelligence solutions.

[2] The CSO also publishes information on the use of ICT by households and public administration bodies.

This study uses data from 2021, 2023, and 2024[3] from Polish companies employing at least 10 people. The scope of the analysis is limited solely to issues related to the use of artificial intelligence technology, excluding other areas covered by the study. The thematic narrowing results from the adopted research objective.

5. Results

To illustrate the dynamics of implementation of artificial intelligence technology by companies by territory, Figure 2 presents data on the percentage of businesses using AI by Voivodeships in 2021, 2023 and 2024. This analysis identifies overall development trends at the national level and regional differences in the pace of AI technology implementation.

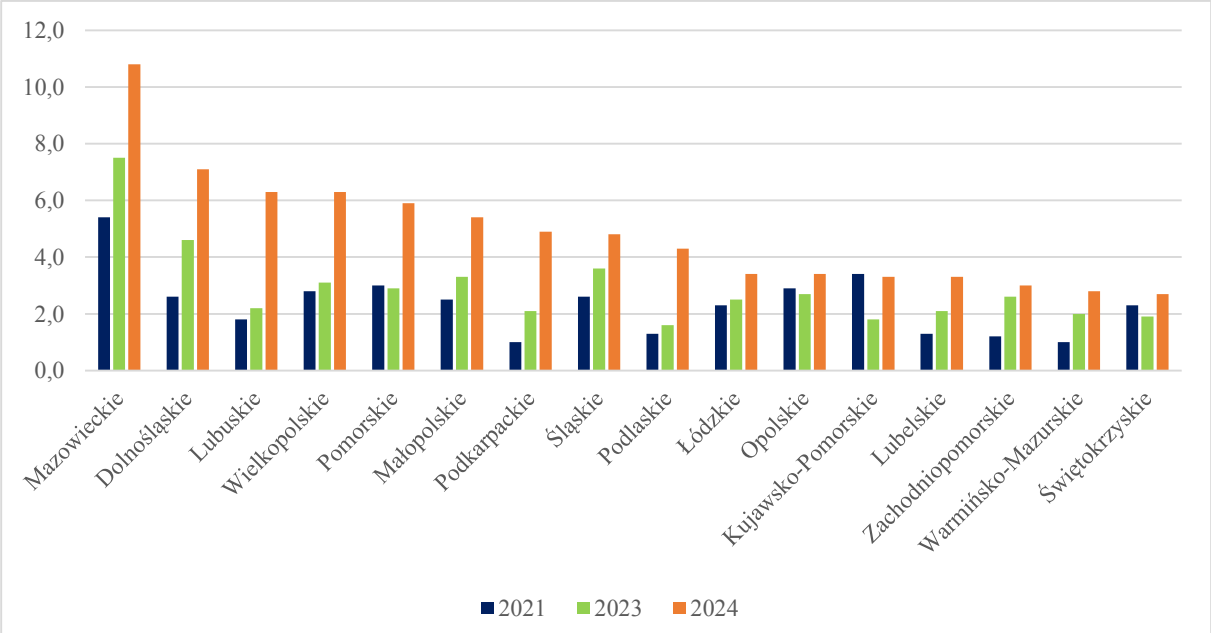

Figure 2. Percentage of businesses which utilise artificial intelligence technologies by Voivodeships in Poland in 2021, 2023 and 2024.

Source: own development based on data from the Central Statistical Office.

In 2024, businesses increased their use of artificial intelligence technology across all Voivodeships compared to 2021. The most significant increase in AI adoption was recorded in the Mazowieckie Voivodeship (from 5.4% in 2021 to 10.8% in 2024, i.e., by 5.4 percentage points). This confirms its dominant position as a Polish centre of innovation and technology. A significant increase in the surveyed indicator was also observed in the Dolnośląskie, Lubuskie and Wielkopolskie Voivodeships (approximately four percentage points over 3 years). Despite the overall upward trend, data analysis reveals regional variations in

[3] No data for 2022.

AI implementation levels. In certain Voivodeships of Eastern and Northern Poland, such as Warmińsko-Mazurskie (2.8% of enterprises using AI in 2024) or Świętokrzyskie (2.7%), the level of AI use remains relatively low, and the change dynamics seem low. The analysis indicates an increasing interest in artificial intelligence technologies among businesses in Poland, though their intensity is strongly influenced by regional factors. These include, in particular, the level of urbanisation, the availability of technological infrastructure, the presence of Research and Development institutions and the general maturity of innovation ecosystems.

The level of AI technology use varies not only by region but also by business type. To capture these differences, Figure 3 shows the percentage of enterprises using AI solutions across selected business sections/areas in 2021, 2023, and 2024. This summary identifies the most technologically advanced sectors and those where the pace of AI implementation remains relatively low.

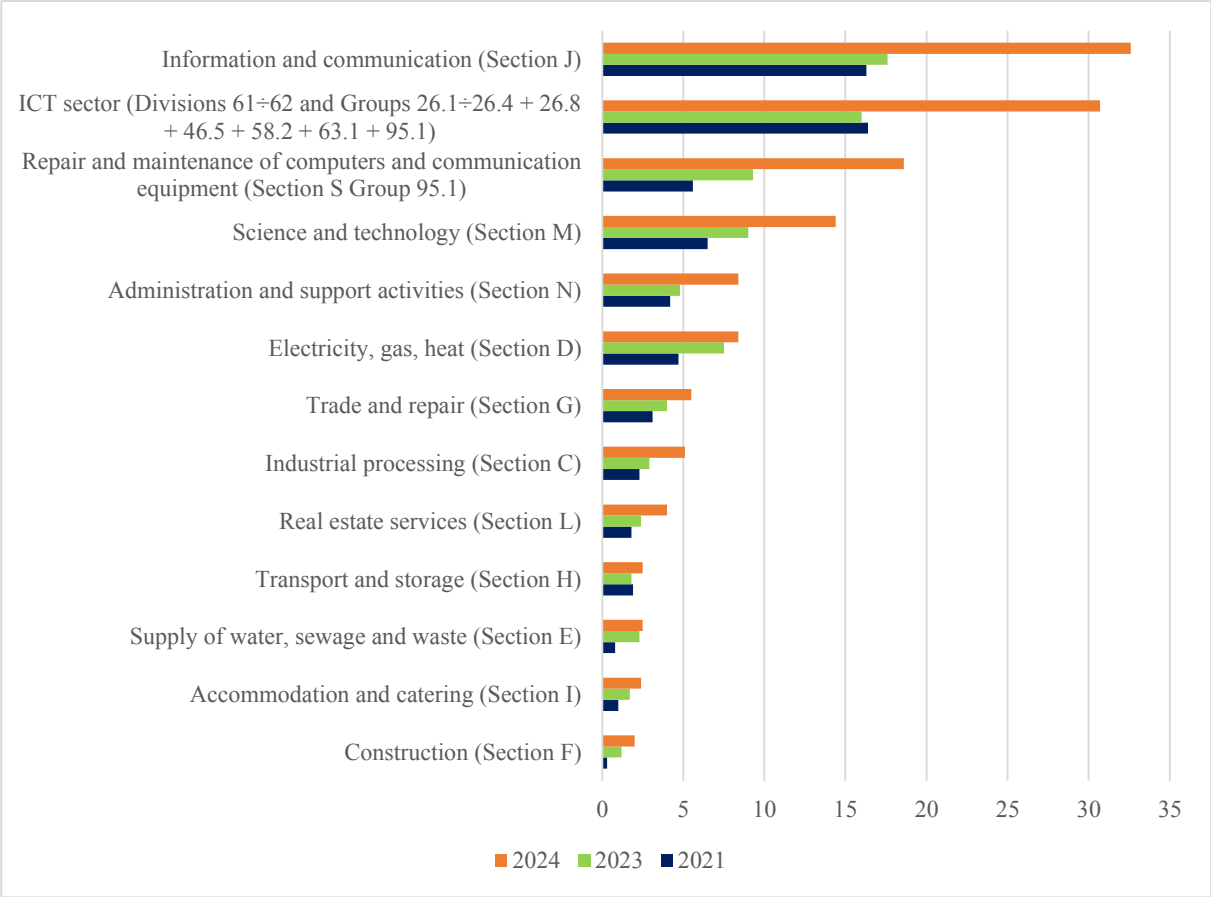

Figure 3. Percentage of businesses which utilise artificial intelligence technologies by type of business activity in 2021, 2023 and 2024.

Source: own development based on data from the Central Statistical Office.

In 2024, the percentage of businesses implementing artificial intelligence technologies across all activities under analysis increased compared to 2021. The highest degree of AI use in 2024 was observed in the Information and Communication section – 32.6%, an increase of 16.3 percentage points from 2021. A similar increase was observed in the broadly defined ICT

sector, where the percentage of enterprises using AI increased from 16.4% to 30.7% (i.e. by 14.3 percentage points). Significant growth was also noted in activities related to the repair and maintenance of computer and communication hardware (13.0 percentage points) and in the scientific and technical sector (7.9 percentage points). The lowest AI adaptation in 2024 occurred in industries such as construction (2.0%), accommodation and gastronomy (2.4%), and transport and storage (2.5%). However, a relative increase in the ratio was also observed in the industries analysed compared with 2021. Variation in AI implementation across companies from different sectors suggests a strong link between their technological advancement and the nature of their operations. The greater intensity of AI applications in the information and communication sectors stems from their specific activities. It is based on data processing, process automation and the integration of digital solutions. In traditional sectors, barriers may be posed not only by technological constraints but also by lower awareness of AI application potential and limited access to adequate human capital and financing.

Figure 4 shows changes in the percentage of companies using artificial intelligence technologies in 2021, 2023, and 2024, accounting for company size and ownership.

Figure 4. Percentage of businesses which utilise artificial intelligence technologies by business size and ownership in Poland in 2021, 2023 and 2024.

Source: own development based on data from the Central Statistical Office.

The data presented in Figure 4 indicate a systematic increase in the percentage of companies using artificial intelligence technologies across all categories analysed over 3 years. The most significant increase in the indicator analysed was observed among large enterprises – from 17.5% in 2021 up to 33.0% in 2024 (i.e. by 15.5 percentage points). In the group of medium-sized enterprises, this percentage increased by 5.4 pp. (from 5.0% to 10.4%), while in the group of small enterprises, by 2.1 pp. (from 1.9% to 4.0%). This indicates a greater capacity

for large companies to invest in advanced technologies. The analysis by form of ownership shows a clear differentiation between entities with domestic and foreign capital. In 2024, the percentage of foreign capital companies using AI technologies was 15.4%, whereas the percentage among Polish companies amounted to 4.7%. The difference was 10.7 percentage points. In 2024, compared to the base year, the increase in the percentage rate under examination was 7.2 pp., respectively for foreign companies (from 8.2% to 15.4%) and 2.8 pp. for domestic companies (from 1.9% to 4.7%). Therefore, companies with foreign capital implement AI technology at a faster pace. This may be the result of better access to know-how, greater experience in digital transformation processes, and often belonging to international corporate networks.

Continuing the analysis of the use of artificial intelligence technology in Polish companies, Figure 5 illustrates the percentage of entities implementing specific types of AI solutions in 2021, 2023 and 2024. The list below allows you to determine which AI technologies are most frequently adopted.

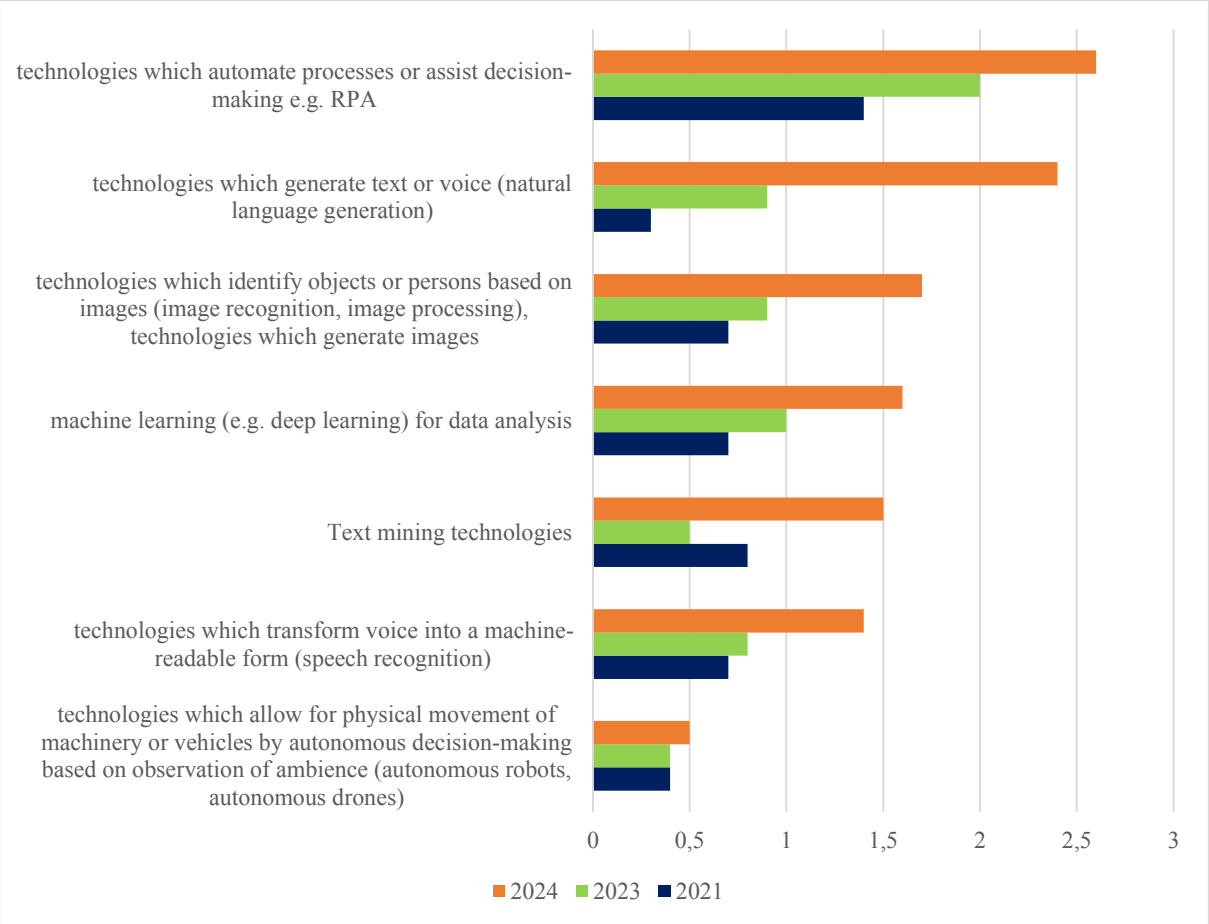

Figure 5. Percentage of businesses which utilise artificial intelligence technologies by technology type in 2021, 2023 and 2024.

Source: own development based on data from the Central Statistical Office.

Compared to 2021, 2024 saw a significant increase in the percentage of companies implementing various artificial intelligence technologies, with a varying growth rate, depending on their type. The most significant increase was recorded in the case of technologies that generate text or voice (natural language generation), where the percentage increased from 0.3% in 2021 to 2.4% in 2024 (i.e., by 2.1 percentage points). The relatively high growth of the examined indicator was also observed for technologies that recognise and process images, which were used by 1.7% of companies in 2024, up from 0.7% in 2021 (an increase of 1.0 pp). Process automation or decision-making technologies have been used relatively frequently during the period under analysis. The percentage of companies benefiting from these solutions increased from 1.4% in 2021 to 2.6% in 2024 (i.e. by 1.2 percentage points). This may indicate a high degree of maturity of such technologies and their usefulness in business processes. In turn, the lowest level of implementation concerns technologies enabling the autonomous movement of machinery or vehicles. Over 3 years, the increase in their use was marginal - 0.4% to 0.5% (i.e., 0.1 pp.). This may result, inter alia, from the limited availability of its applications and relatively high implementation costs.

In addition to previous analyses of the scale of artificial intelligence implementation in Polish companies, Figure 6 depicts the barriers that limited its implementation in 2021, 2023, and 2024. This makes it possible to understand better the structural, technical and organisational challenges of digital transformation and to identify areas requiring support from institutions and/or support in terms of competences.

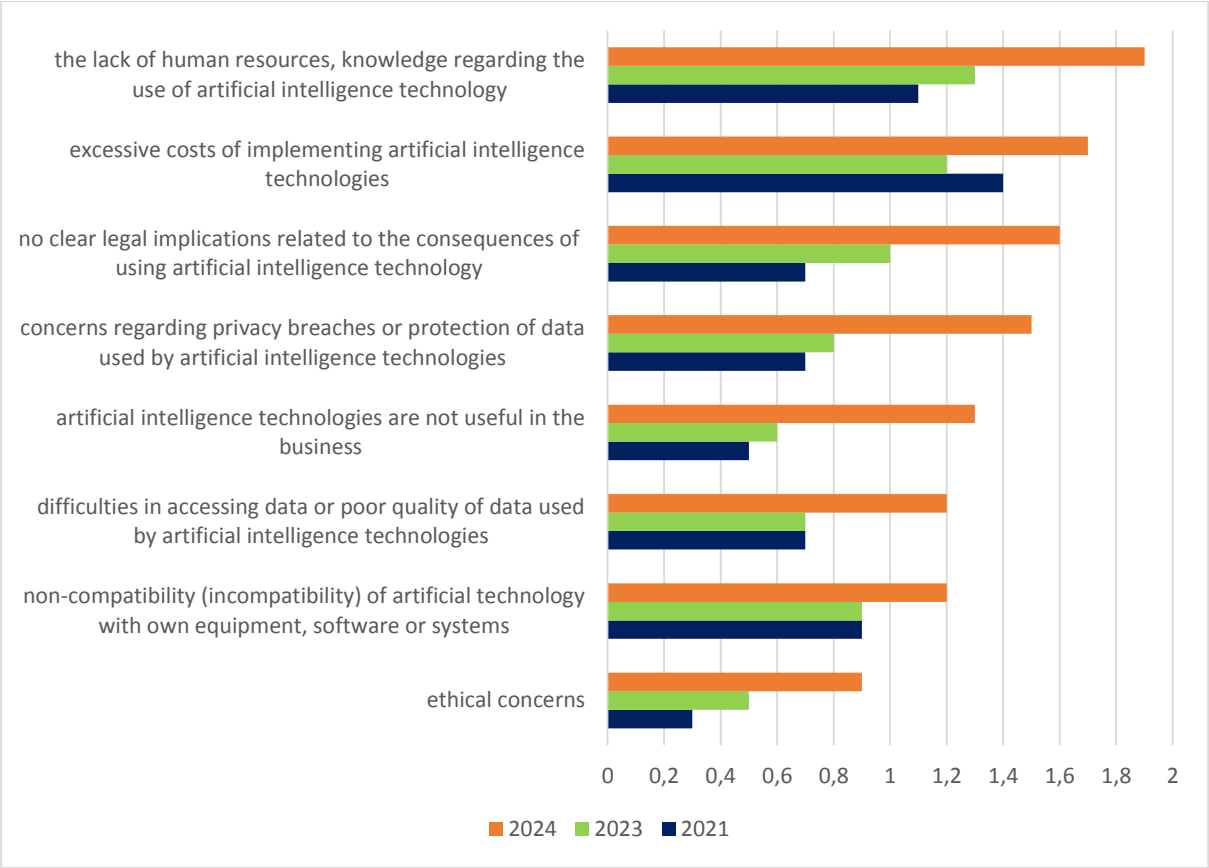

Figure 6. Percentage of enterprises which do not use artificial intelligence technologies due to their non-use in Poland in 2021, 2023 and 2024.

Source: own development based on data from the Central Statistical Office.

The figures shown in Figure 6 indicate that in 2021, 2023, and 2024, the main barriers limiting the use of artificial intelligence technology in enterprises were financial, human, and legal. In 2024, the most common barrier was the lack of human resources and knowledge of AI use. This factor was identified by 1.9% of companies, an increase of 0.8 percentage points from 2021. A similar increase was observed in the case of excessive costs related to implementing AI technology, which became a barrier for 1.7% of operators in 2024 (a rise of 0.3 pp.). The importance of privacy and data protection concerns also increased significantly from 0.7% in 2021 to 1.5% in 2024 (i.e., by 0.8 pp). At the same time, confusion about the possible legal consequences of AI implementations has increased. This factor was a barrier for 1.6% of enterprises in 2024, up from 0.7% three years earlier. There is also an increase in the importance of the technical obstacles: the incompatibility of AI technology with existing infrastructure was indicated by 1.2% of enterprises in 2024 (an increase from 0.9% in 2021), and the difficulty in accessing data or their low quality, also by 1.2% (an increase from 0.7%). Ethical concerns (growth from 0.3% in 2021 to 0.9% in 2024) and the belief that AI technologies are not helpful to the company (from 0.5% to 1.3%) were among the least frequently identified barriers.

In order to provide a summary of the diversity of AI technology use in enterprises in 2024, table 3 lists the maximum and minimum values broken down by region, industry, enterprise size, ownership type, and type of technology used. These results allow for quick identification of areas with the highest and lowest levels of AI adoption.

Table 3.
Summary of results

No.	Category	Maximum (data for 2024)	Minimum (data for 2024)
1	Percentage of businesses which utilise artificial intelligence technologies by Voivodeships	Mazowieckie	Świetokrzyskie
2	Percentage of businesses which utilise artificial intelligence technologies by type of business activity	Information and communication	Construction
3	Percentage of businesses which utilise artificial intelligence technologies by business size	Large	Small
4	Percentage of businesses which utilise artificial intelligence technologies by ownership	International ownership	National ownership
5	Percentage of businesses which utilise artificial intelligence technologies by technology type	Technologies which automate processes or assist decision-making e.g. RPA	Technologies which allow for physical movement of machinery or vehicles by autonomous decision-making based on observation of ambience (autonomous robots, autonomous drones)
6	Percentage of enterprises which do not use artificial intelligence technologies due to their non-use	The lack of human resources, knowledge regarding the use of artificial intelligence technology	Ethical conerns

Source: own elaboration.

Data analysis indicates that the use of AI technology is most widespread in the Mazowieckie Voivodeship, in the information and communication sector, in large enterprises and in companies with international capital. The lowest level of AI adoption is observed in the Świętokrzyskie Voivodeship, in the construction industry, in small enterprises and in companies with domestic ownership. Technologies that automate processes and support decision-making are used much more frequently than autonomous machine and robot technologies. The lack of AI use is primarily due to staffing constraints and knowledge gaps, while ethical issues play the smallest role in this regard.

6. Conclusion

The analysis shows that the level of artificial intelligence use in Polish companies is relatively low and highly diverse across regions and industries. The most significant activity in this area is displayed by entities located in highly urbanised, technologically developed regions,

as well as companies operating in the information and communication sector with a share of foreign capital. In turn, smaller businesses operating in traditional industries and less developed regions are much less likely to implement AI solutions. Data from the Central Statistical Office shows that financial constraints, a lack of qualified personnel, and a low level of technological awareness remain the key barriers to the implementation of artificial intelligence. In light of these findings, it is necessary to intensify efforts to support the development of digital competences, to promote knowledge of the possible applications of AI, and to stimulate innovation in less advanced industries and regions of Poland. Factors such as state policy, strengthening local innovation ecosystems and creating conditions conducive to investing in modern technologies should play a key role.

If Poland aims to compete effectively in the so-called knowledge-based economy, a systematic approach to digital and technological transformation is required, taking into account both the potential and the constraints faced by various groups of companies in this area. Artificial intelligence can therefore play a key role in building resilience, flexibility and competitive advantage of Polish businesses.

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