



28th European Conference on Artificial Intelligence (ECAI 2025)

## DIGITAL INNOVATION AND ARTIFICIAL INTELLIGENCE (AI) AS A TOOL FOR BUILDING COMPETITIVENESS OF THE SME SECTOR

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### ABSTRACT

**Purpose:** *The main purpose of the article is to indicate the importance of digital innovation in the SME sector with a special focus on the role of AI in building the competitiveness of enterprises.*

**Need for the study:** *Digital transformation, including the use of artificial intelligence AI, is a relatively new area in which all the world's top developed economies are trying to find their edge. In order to win this race, investment in the development of digital and AI technologies and competencies is essential in the EU.*

**Methodology:** *Literature studies, secondary data analysis, comparative analysis, logical inference and deduction methods were used. In addition, the authors also shared their own knowledge and professional experience, including business.*

**Findings:** *Based on the research, a number of barriers were identified that SMEs in Poland face in their attempts to obtain financial resources from EU funds for the implementation of innovative projects. The most important ones include: the lack of product or process innovation in the presented projects at least on a national scale and the lack of ability to finance own contribution.*

**Practical Implications:** *The presented research and results should be used by institutions creating policies to support economic development at the level of countries and the European Union as a whole. The results of the research can also be used by institutions supporting the development of innovation, including digital innovation, in the SME sector in determining the terms of competitions and financial support.*

**Keywords:** Artificial Intelligence (AI); Innovation; SME sector; Industry 5.0; Digital transformation; Smarter Europe

**Jel codes:** F63; O3; L26

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### 1. INTRODUCTION

Digital transformation and the development of modern technology are considered key to strengthening entrepreneurship and economic competitiveness. It is also of great importance in creating the economy's resilience to digital crime threats. Therefore, it is essential to support the development of digitization in

both the public and business sectors as a tool for secure digital development of the economy. The complexity of the process and the seriousness of the challenges faced by the participants in this process require specific measures to support entities that, due to their financial and organizational potential, may have problems implementing innovative digital considerations into their operations. One of the many challenges facing modern enterprises is the process of acquiring, aggregating and selecting technical knowledge. In this context, special attention is paid to supporting SMEs (micro, small and medium-sized enterprises) by allowing them easier access to advanced technologies, including in the area of intelligent business management. This will enable companies to innovate more effectively, increase efficiency and better respond to the challenges of digital transformation.

The SME sector plays a key role in the global economy and is one of the most important pillars for the development of national economies. Its importance stems both from the number of enterprises in operation and their impact on job creation, innovation, competitiveness and regional development.

One of the main strengths of the SME sector is its flexibility and ability to adapt to changing market conditions. The size and structure of companies in this sector enable rapid decision-making, which allows them to take better advantage of opportunities and better adapt to new trends.

The main purpose of the article is to indicate the importance of digital innovation in the SME sector with a special focus on the role of AI in building the competitiveness of enterprises. The specific goal is to present the issue of innovation, including digital innovation, in the policies of the European Union and on the example of a selected member country. The research questions posed were: What are the opportunities for the development of digital innovation of SMEs in the EU? What are the barriers to the development of innovation in the SME sector in Poland?

## 2. LITERATURE REVIEW

Classical factors of production, i.e. land, labor and capital, are not the only ones that affect the construction of sustainable competitive advantage of enterprises, and consequently further economies. In today's global economy, entrepreneurship, knowledge, innovation of technological solutions play an important role in creating conditions for the development of competitive enterprises. A rich literature on the sources of competitive advantages in a globalized economy confirms this: Zysk (2024), Mariani et al. (2023), Widayanti and Meria (2023). According to numerous authors, e.g. in the third decade of the 21st century, artificial intelligence (AI) and its development, which can determine groundbreaking, innovative, important technological solutions such as ChatGPT, is definitely becoming a priority in creating competitiveness at the enterprise level. It has been a huge success and is considered here as, a landmark event in the development of civilization. ChatGPT was publicly released on November 30, 2022, largely as a technology demonstration. Two months later, it had already attracted an estimated 100 million active users – making it the fastest-growing consumer application in history, as highlighted by Hu (2023). This spectacular example of the digital revolution in the 21st century shows that time is of the essence when it comes to new technological solutions that can give a competitive advantage in the marketplace, which is no longer counted in years, but in months and weeks and perhaps sometimes in days.

In the dynamic and turbulent business system that makes up the global economy, the role of innovation, digitization and the use of artificial intelligence (AI) in creating competitive advantages is becoming a key element of management at the operational and strategic levels. This is reflected in the concept of building Industry 5.0 (Slavic et al., 2024; Wang et al., 2023), which is widely described in the literature. It is based on digital innovations and develops the ideas of Industry 4.0 with elements emphasizing the need to develop interaction between man and machine (Coelho et al., 2023). The new approach points to the vital importance of personalization, creativity and advanced cooperation between technology and people in all aspects of economic life. In this new concept of economic development, three key components are distinguished (Grabowska et al., 2022; Nahavandi, 2019):

- human-centric – shifting the focus from efficiency, production efficiency to employee welfare, competence and development,
- sustainability – indicating issues of circular economy, minimization of environmental damage and use of green energy,

- resilience – related to the operation of the organization in a turbulent technological, economic and geopolitical environment.

Numerous studies indicate that in the face of dynamic changes in the economic environment, the main factor determining the necessary changes that must occur in companies is the rapid development of technology, including innovation, artificial intelligence, the Internet of Things (IoT), data analytics and process automation (Jiang et al., 2024; Xu et al., 2021; Yavari & Pilevari, 2020). By implementing tools specific to Industry 5.0, companies can gain a competitive advantage by optimizing processes and eliminating inefficiencies. Analytical tools, such as predictive maintenance and real-time data analysis, reduce downtime, improve resource allocation and increase productivity (Goujon et al., 2024; Tyagi et al., 2023). This is particularly important for building the competitiveness of SME players.

Management of any organization is a complex and multifaceted process, and effective tools are needed for its proper and efficient implementation (Santalova et al., 2019). Griffin (2005) defines management as a set of activities, such as planning, decision-making, organizing and leading, and controlling, which are directed at human, financial, physical and information resources. In the era of globalization, the management of an SME enterprise covers many areas of activity and requires a high level of labor and coordination of many activities, which translates into time-consuming processes and involves certain financial outlays (Bashan & Kordova, 2021). The use of appropriately selected innovative tools can affect more efficient implementation of processes, lowering the labor input and time of performing activities. Chen et al. emphasize that in the face of progress in the area of digitization, traditional methods of financial management in the enterprise are becoming obsolete (Chen et al., 2023).

The application of AI in the SME sector covers a range of areas, from data analysis to forecasting market trends. With learning capabilities, AI-based management systems will continue to improve. Already, these systems have the ability to identify events that may reveal new business opportunities or potential competitive threats (Griesch et al., 2024; Kedi et al., 2024). The implementation of digital considerations using AI can support decision-making processes, providing decision-makers with comprehensive analysis and recommendations based on large amounts of data. The use of AI in SMEs can bring numerous benefits (Mohd Suki, 2024; Yurdagel & Baycur, 2024). First, it enables faster and more precise data analysis, thereby speeding up and rationalizing the decision-making process. Second, through continuous learning and expansion of databases, AI systems provide up-to-date and currently required information to managers. In addition, AI gains the ability to identify non-obvious trends, making it possible to create flexible strategies adapted to the changing business environment (Aslam & Martha, 2024; Morshed et al., 2024). In the area of management in the SME sector, where it is often impossible to hire adequate specialists, the use of artificial intelligence plays a key role, enabling a better understanding of the competitive environment. This can result in more efficient and smarter business management.

It is necessary to introduce into management practice tools that enable analysis of large data sets (Big Data), allowing to more accurately forecast demand, optimize the commitment of capital, inventory, human resources. The availability of real-time data from various sources allows effective monitoring and management of all processes occurring in the enterprise (Cao & Zhai, 2022; Gadde, 2024). The use of 'Big Data' also leads to the minimization of risks associated with the turbulence of the modern economy (Lagap & Ghaffarian, 2024). Big data is a term for very large, diverse and rapidly growing data sets that are too complex to analyze with traditional data processing tools and methods.

According to McKinsey (2021), companies using AI-based tools in production and supply chain management report optimizing operating costs and reducing them by about 10–20% through the implementation of AI. In addition, a study by Deloitte Report (Dutt et al., 2024) indicates that among the other benefits companies expect from generative AI are: (1) improve efficiency and productivity; (2) improve existing products and services; (3) encourage innovation and growth; (3) shift workers from lower to higher value tasks; (4) increase speed and/or ease of developing new systems / software; (5) increase revenue; (6) enhance relationships with clients / customers; (6) uncover new ideas and insights; (7) detect fraud and manage risk. At the same time, the Deloitte Report emphasizes that the greatest value and strategic differentiation will likely come from using the technology to innovate. First, by helping to generate new products, services and capabilities that wouldn't be possible otherwise. And second, by enabling new business models and ways of working across an enterprise.

In summary, AI is becoming an increasingly important tool in building the competitiveness of enterprises in the globalized economy and at the same time a requirement of modern management in the

strategic and operational dimensions. Using digital innovations including generative AI, companies increase their operational efficiency, make better strategic decisions and flexibly adapt their offerings to changing market conditions. Such activities are part of the definition of smart business management.

On the other hand, it should be remembered that artificial intelligence is not just “ordinary technology” and there are many risks associated with it (Kaur et al., 2023). The problem to be solved remains the question of its further development and control by, among other things, setting “specific boundaries” not only ethical (Bostrom, 2020; Müller, 2021) but also regulated by law (Buiten, 2019; Xenidis & Senden, 2020). This is important from the point of view of the functioning of humans, businesses, as well as societies (Makridakis, 2017), since it is known that AI is capable of simulating human thinking as well as behavior. Consequently, today one can identify many areas of AI threats such as cyber-attacks on the infrastructure of enterprises or critical infrastructure of countries, fake news, arms race, deliberate violation of the rights or freedoms of people/societies, among others. AI can be a useful tool in the creation and pursuit of sustainable socio-economic development of countries, but also a tool used in armed conflict, terrorism, struggle for influence and domination in the global economy (Polcumpally, 2024; Xue & Guo, 2024). Moreover, it is worrisome that AI leaders are pessimistic about the social impact of the technology. The concern is about serving only one organization or one country. When as many as 52% of AI leaders said they expected widespread use of generative AI to centralize power in the global economy, while 30% expected it to more evenly distribute global power. Similarly, 51% expected generative AI to increase economic inequality, while 22% expected it to reduce inequality (Dutt et al., 2024).

Taking into account the above risks, the following are indicated as important for risk management in the implementation of generative artificial intelligence (Dutt et al., 2024):

- monitoring regulatory requirements and ensuring compliance,
- establishing a governance framework for the use of generative AI tools/applications,
- conducting internal audits and testing on generative AI tools/applications,
- training practitioners how to recognize and mitigate potential risks,
- ensuring a human validates all generative AI content,
- using a formal group or board to advise on generative AI-related risks,
- keeping a formal invent of all generative AI implementations,
- using outside vendors to conduct independent audits and testing,
- single executive responsible for managing generative AI-related risks.

Observation of economic trends prohibits that artificial intelligence is being used in many industries in the area of customer relationship management as well. Thanks to digital transformation, Chatbots and recommendation systems implemented at the enterprise level enable companies to build strong customer relationships, personalize goods and services and create flexible offerings. Flexible personalized offerings that coincide with identified consumer expectations are the way to generate increased product sales, and thus higher revenues. Changes in the way we communicate and also gather and process information, which have occurred since the dissemination of tools such as ChatGPT developed by OpenAI, affect many areas of management, including the process of operational and strategic management (Ayinde et al., 2023; Wagner et al., 2022). The transformation and evolution of AI-based technologies, makes innovative digital technologies an increasingly integral part of competitive strategies, enabling the improvement of market analysis tools, identification of trends, and, above all, flexible adaptation to changes in the socio-economic environment (Abu-Alfoul, 2023). The high efficiency and speed of artificial intelligence is a potential for reducing employment in the long term and in the perspective of reducing wage costs, reducing costs relating to the entire value chain of the organization by means of streamlining business processes in the organization (Sofiyah et al., 2024). Artificial intelligence, in the context of its use in building the competitiveness of enterprises, is becoming a set of increasingly advanced technologies that enable an enterprise to understand its environment, process information and make decisions leading to the efficient use of its resources, including human resources. The implementation of AI allows the automation of repetitive tasks, which frees employees from routine and allows them to focus on more desirable activities for businesses (Abu-Alfoul, 2023; Ayinde et al., 2023). As a result, companies that use AI can better manage human capital, which is becoming an increasingly scarce resource these days.

Increasing the competitiveness of SME companies depends primarily on their innovations. Companies that more intensively implement innovative digital solutions are more likely to introduce such innovations. Collaborating in this process with IT and R&D entities (Lewandowska, 2021).

Deloitte's survey (Dutt et al., 2024) of business and technology leaders indicates that interest in the enterprise sector in artificial intelligence remains high. The impact of digital transformation is expected to be clearly visible in the next three years. The vast majority of respondents (79%) said they expect artificial intelligence to drive transformation in their organizations and industries over the next three years. Nearly a third expect significant transformation to occur now (14%) or in less than one year (17%). Most organizations rely primarily on off-the-shelf digital solutions using AI. This is characteristic of the SME sector which needs standard and low-cost solutions. This is due to the organizational potential of these companies as well as the amount of capital they have. Among these solutions, the most common are:

- productivity applications with integrated generative artificial intelligence (71%),
- enterprise platforms with integrated artificial intelligence (61%),
- publicly available large language models (LLMs) (56%), such as ChatGPT.

So, it seems right to observe that AI is changing business, the economy and society, impacting experiences and relationships between stakeholders and citizens. In the race to implement AI solutions in the enterprise, it is the characteristics of the organization, such as adaptability, flexibility, willingness to experiment, that will be crucial. Technology continues to evolve and influence the business landscape, so it is imperative for both current and future entrepreneurs to be proficient in using advanced tools such as AI (Giuggioli & Pellegrini, 2023).

### 3. METHODOLOGY

Verification of the research question and the realization of the stated goal was carried out on the basis of various research methods. Literature studies, secondary data analysis, comparative analysis, logical inference and deduction methods were used. Literature was reviewed and analyzed from the fields of mainly: innovation, artificial intelligence AI, entrepreneurship and competitiveness of SMEs, socio-economic development of the European Union.

Additional authors also shared their own professional knowledge and experience, and that of business. In particular, the theoretical and practical knowledge gained while working as an expert within the Evaluation Committees of Projects of small and medium-sized enterprises applying for European Union funding proved useful in the work. The projects were aimed at developing and strengthening the research and innovation capacity of enterprises, targeting the implementation of product or process innovations, as well as the digitization and transformation of enterprises (also as part of the construction of intelligent management systems) towards sustainable development, .

The research was also based on data available from national and international public statistics. Documents published by organizations such as the World Intellectual Property Organization (WIPO), Deloitte, the European Commission, the National Bank of Poland, the Polish Agency for Enterprise Development and Statistics Poland, among others, were used in this regard. The work mainly uses the latest available data. The territorial scope of the research covers the area of the European Union, with particular emphasis on Poland.

### 4. RESULTS

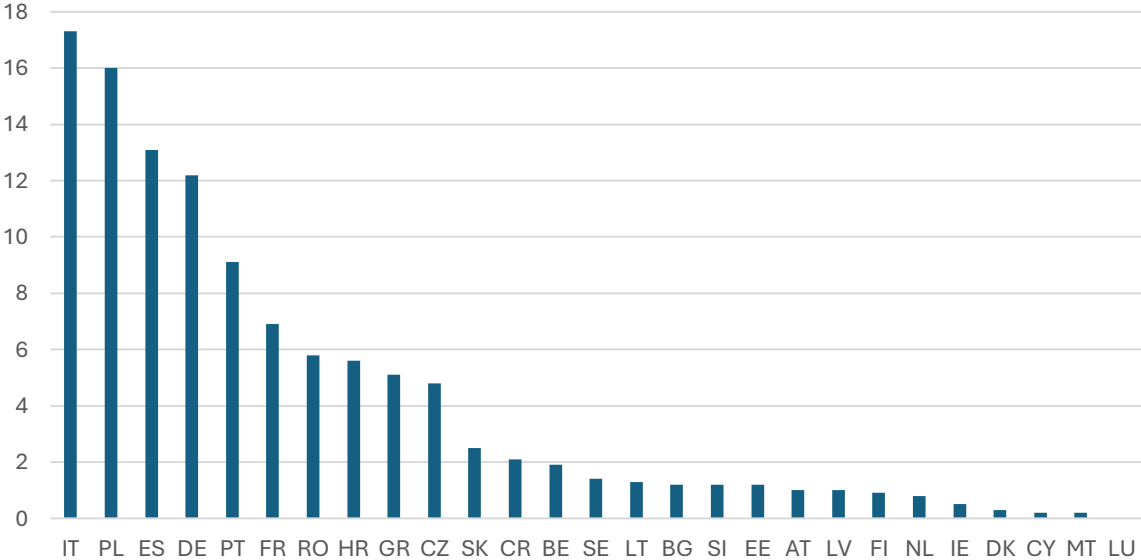
#### *4.1. Innovation as an element of EU policy*

Numerous studies indicate that innovation is key to the development of economies. Mendez et al. (2013), in their research, confirmed that it is innovation that can drive up to 80% of economic growth in developed countries, while investment by less developed countries in innovation can improve the export performance of a sector considered crucial in the context of low business competitiveness and domestic demand. Therefore, the amount of funding allocated in the European Union for research and development supporting innovation has gradually increased. Since 2000, the investments in research and innovation (R&I) under Cohesion Policy have grown exponentially: from €26 billion in the 2000-

2006 period to over €86 billion in 2007–2013, to €121 billion in the 2014–2020 period (Council of the European Union, 2021). In the latest financial perspective 2021–2027, a total of €137.5 billion is programmed for the innovation and digital economy priority alone. The first strategic objective of the EU Cohesion Policy for 2021–2027 is “A more competitive and smarter Europe” (so-called PO1). Under this objective, projects are planned and already underway to contribute to the following specific objectives:

- developing and enhancing research and innovation capacities and the uptake of advanced technologies (total budget €53.3 bn),
- enhancing sustainable growth and competitiveness of SMEs and job creation in SMEs, including by productive investments (total budget €37.2 bn),
- enhancing digital connectivity (total budget €3.6 bn),
- reaping the benefits of digitization for citizens, companies, research organizations and public authorities (total budget €15.9 bn),
- developing skills for smart specialisation, industrial transition and entrepreneurship (total budget €2.5 bn).

Italy is scheduled to receive the most funds for the OP1 objective (€17,325 bn), followed by Poland (€16,037 bn) and Spain (€13,058 bn). Luxembourg, on the other hand, will not receive EU funds for this purpose. Malta (€0.184 bn) and Cyprus (€0.245 bn) have the smallest budgets. Figure 1 shows the total budgets of individual EU members for the goal of building Smarter Europe.



**Figure 1.** Total Budget by country UE: P01 – Smarter Europe, EUR Billion  
*Source:* own elaboration based on Cohesion Open Data Platform.

One of the key barriers to the development of digital innovation in companies is the gap in good examples and their applications that could be benchmarked. A benchmarking strategy is a process in which an organization compares its processes, products, services or results with the best practices and performance of other companies, usually leaders in a particular industry. The goal of benchmarking is to identify areas that can be improved and implement solutions that will help the organization gain a competitive advantage. That is why it is so valuable to observe how companies in the European Union, especially Italian, Polish and Spanish entrepreneurs, will use the funds under PO1. Digital transformation projects and the use of AI to build competitive advantages will obviously be key in this regard, also in the area of smart SME management

*4.2. Innovativeness of the Polish economy*

According to the Global Innovation Index, from 2011 to 2024, Poland ranked between the lowest 49th (in 2013) and 38th (in 2017, 2020, 2022). According to the latest data, in 2024 it occupied the 40th position and this was one place higher compared to 2023. Increasing the level of innovativeness of the

Polish economy is possible only if SME entities are involved in the process. An analysis of statistical data on the development of the SME sector in Poland reveals it is an extremely important and dynamic element of the Polish economy. According to data from the Statistics Poland, in 2024 there were more than 2.3 million enterprises in Poland, of which up to 99.8% were SMEs. Details of the sector are provided in Table 1. SMEs generate 45.3% of Poland's GDP and employ more than 55.9% of workers in the private sector. They are therefore a key element of the Polish economy, affecting its stability and growth.

**Table 1.** Characteristics of the SME sector in Poland

| <b>Number and structure of enterprises</b> | <b>Poland</b> |       | <b>EU-27</b> |       |
|--|---------------|-------|--------------|-------|
| Number of enterprises                      | 2 668 101     | 100%  | 31 997 696   | 100%  |
| Micro                                      | 2 554 874     | 95,8% | 30 119 467   | 94,1% |
| Small                                      | 93 624        | 3,5%  | 1 578 948    | 4,9%  |
| Medium                                     | 16 002        | 0,6%  | 246 577      | 0,8%  |
| <b>Employees in enterprises</b>            | <b>Poland</b> |       | <b>EU-27</b> |       |
| Number of employees in enterprises         | 11 489 622    | 100%  | 156 124 230  | 100%  |
| Micro                                      | 4 265 808     | 37,1% | 47 004 556   | 30,1% |
| Small                                      | 1 843 959     | 16,1% | 29 467 249   | 18,9% |
| Medium                                     | 1 641 083     | 14,3% | 24 009 260   | 15,4% |

*Source:* own elaboration based on Zadura et al. (2024).

According to the latest available data Statistics Poland there were 2847 companies employing 10 people or more in the ICT sector in 2023, of which 92.7% provided ICT services. Slightly more than 80% of ICT service enterprises were IT service providers. The number of people working in the ICT sector was 324500. IT services constituted the area of enterprises with the highest number of employees among all those employed in ICT services (79.2%). The value of net sales revenue in the ICT sector in 2023 amounted to PLN 269.8 billion, with an annual increase of 2.6%. Services made the largest contribution to the ICT sector's revenue generation. Their share in the revenue of the entire ICT sector was 81.5%. In 2023, almost a third of enterprises provided their employees with training to improve ICT skills (31.4%). One in five enterprises used open public data (19.5%).

Among ICT companies in 2023, more than a third of revenues were generated by companies providing IT services (44.7%, up 4.7 percentage points from a year earlier). Telecommunications services companies came in second with a share of 18.6%. It is these enterprises that are also most responsible for the positive trade balance in the Polish services trade balance.

A systematic and rapid development of Poland's foreign trade in innovative and knowledge-based services was observed between 2010 and 2023. The total value of exports of these services increased from PLN 18.8 billion in 2010, to PLN 155.4 billion in 2023, or by 825%. In turn, the value of service imports increased from PLN 21.1 billion to PLN 112.9 billion. This represents a marked increase of 535%. The trade balance in this category was negative in 2010-2014, with a steadily increasing balance in subsequent years, reaching PLN 42.4 billion in 2023. As can be seen in the case of the analyzed group, the growth rate of imports was also much lower than the growth rate of exports of services.

An analysis of the innovative and knowledge-based components of Poland's trade in services shows that there were significant changes from 2010 to 2023, including an 825.1% increase in exports and a 289.4% increase in imports. It is significant that Poland achieved a trade surplus for 2023 of the following components: Telecommunication, IT and information services, Research & development services, and Services provided by professionals. Only the component Fees for intellectual property rights showed a negative trade balance, which worsened compared to 2010. Unfortunately, Polish entrepreneurs have to pay fees for copyrights, patents, trademarks or design rights in many cases (see table 2.).

The share of innovative and knowledge-based services increased in Poland's foreign trade in services in 2023 compared to 2010, with exports rising from 17.9% to 23.5% and imports from 34.0% to 40.7%. This is obviously a positive change. However, it should also be pointed out that the value of service exports as a proportion of GDP decreased in Poland in 2023 to 13.4% (compared to 13.7% in 2022). It remained at a lower level than the European Union average (16.3%). An additional barrier is the

dominance of equity-linked entities in both exports and imports of services. For example, in 2023, only 15.6% of domestic entities were responsible for the export of services of the Telecommunication, IT and information services component, and only 1.6% for the Fees for intellectual property rights component (Międzynarodowy Handel Usługami Polski w 2023 Roku, 2024).

**Table 2.** Poland's foreign trade turnover by the main components of innovative and knowledge-based services in 2010 and 2023 (PLN bln)

| Service  | 2010   |        |               | 2023   |        |               | 2023/2010 [%] |        |
|--|--------|--------|---------------|--------|--------|---------------|---------------|--------|
|  | Export | Import | Trade balance | Export | Import | Trade balance | Export        | Import |
| Telecommunication, IT and information services | 6,1    | 6,6    | -0,6          | 70,7   | 46,3   | 24,4          | 1168,3        | 699,0  |
| Research & development services                | 1,7    | 0,5    | 1,2           | 12,7   | 2,6    | 10,1          | 748,6         | 563,0  |
| Services provided by professionals             | 10,4   | 7,3    | 3,1           | 66,2   | 44,4   | 21,8          | 638,2         | 611,0  |
| Fees for intellectual property rights          | 0,7    | 6,8    | -6,1          | 5,7    | 19,6   | -13,8         | 811,2         | 289,4  |
| Total  | 18,8   | 21,1   | -2,3          | 155,4  | 112,9  | 42,4          | 825,1         | 534,6  |

Source: own elaboration based on National Bank of Poland data.

The authors' experience of working with the SME sector indicates that the reason for this state of affairs is the low awareness of entrepreneurs of the benefits of implementing innovative digital solutions. The most frequently cited are concerns about the complexity of the entire process of implementing digital technologies and fear of using AI in business. The problem is the low level of knowledge regarding the implementation of digital innovations and the specific opportunities brought by the use of AI in business processes. Certainly, things are not made easier by the lack of credible examples of implementation of these technologies in similar companies in the industry. This also means a lack of competitive pressure to implement AI, which would certainly influence greater openness to swap.

Not surprisingly, according to the Digital Economy and Digital Society Index (DESI) in 2022, Poland ranked 24th among the 27 European Union member states. The report positively assessed the development of public services in Poland. Over the past few years, there has been an increase in the number of users using services provided by the administration electronically, from 49% in 2019 to 55% in 2022. It is also encouraging to see an increase in the number of ICT specialists<sup>1</sup> from 3.1% of the working population aged 15–74 in 2019 to 3.5% in 2022, however, this result is below the EU average of 4.5% (European Commission, 2022).

The problem with the implementation of digital technologies in the SME sector in Poland is also evidenced by the value of the Digital Intensity Index. In 2024, more than two-thirds of Poland's enterprises are categorized as having very low or low digital intensity. Only 26.7% of SME enterprises were categorized as having high or very high intensity. Taking into account the type of business, high or very high intensity was most often characterized by entities engaged in information and communication (88.0%), while the highest percentage of enterprises with very low digital intensity was recorded in the construction section (46.9%).

One of the tools for developing the competitiveness of Polish enterprises under PO1 is a program called Smart Path, implemented by the Polish Agency for Enterprise Development (PARP). Its objective is to develop and strengthen the research and innovation capabilities of enterprises, aimed at implementing product or process innovations (at least at the national level) and the digitization and transformation of enterprises towards sustainable development, as well as the internationalization of enterprises and the increase of personnel competence. The program allows funding for digital transformation and ensuring cyber security of the Applicant's business operations. Activities planned in the module must lead to the implementation of a product or process innovation at least at the enterprise level. The Smart track is a comprehensive support for the activities of micro, small and medium-sized

enterprises, in particular, strengthening research and development capabilities and implementing innovations based on the results of R&D work.

The authors of the article, as PARP experts, participated in the evaluation of more than 100 projects under SMART. Own observations related to the process of implementation of the program and observations of other experts with whom discussions were held on this subject indicate the advisability of implementing such projects. This is because they are an opportunity for the SME sector to establish cooperation with the R&D sector and increase the innovativeness of their products and services. More than 5,600 applications submitted suggest that companies are looking for projects that allow them to finance the costly process of creating their competitiveness.

**Table 3.** Characteristics of competitions for SMEs in Poland supporting the development of innovation under the SMART and SMART Accessibility programs co-financed by the EU

| Competition number | Number of applications submitted | Total budget in PLN | Number of projects with funding |
|--------------------|----------------------------------|---------------------|---------------------------------|
| 1.                 | 1540                             | 1,883 bn            | 198                             |
| 2.                 | 2722                             | 1,4 bn              | 201                             |
| 3.                 | 148                              | 222 million         | 13                              |
| 4.                 | 1081                             | 2,1 bn              | unfinished                      |
| 5.                 | 91                               | 222 million         | unfinished                      |

*Source:* own elaboration.

It should be pointed out that under the SMART Path programs, support can be given to projects that result in product or business process innovations relating to business functions (as defined in accordance with Oslo Manual 2018) in the production of products or services. Also eligible under the competition are costs that lead to the development of innovations in intelligent business management systems, which could then be sold on the market. In addition, as part of the planned tasks within the framework of research work and industrial research, entrepreneurs can apply for support for the purchase of modern enterprise management systems, if this is reasonable, rational and related to the purpose of the project. Thus, the SMART Path supports enterprises in the development of modern tools, including AI in support of intelligent management processes in two ways. Projects in the subject area were submitted by SMEs and the authors participated in their evaluation. It can be pointed out, for example, that one of the more common areas of evaluated projects was the use of AI in infrastructure and renewable energy management or the implementation of ERP systems.

At the same time, the small percentage of projects that have been recommended for funding indicates the numerous problems encountered by the SME sector in these activities. Mistakes made by Applicants at the application stage, jump to the variety of problems faced by entrepreneurs. Based on their own experience and observations, the following should be mentioned first and foremost:

- lack of product or process innovation in the submitted projects at least on a national scale,
- lack of ability to finance the necessary own contribution, including the applicant's poor financial condition or the scale of the project exceeding the applicant's financial capacity,
- lack of good knowledge of the competition documentation, which resulted in the preparation of applications with errors,
- overly complicated provisions of the project selection regulations,
- highly elaborate competition documentation,
- difficulties in prioritizing expenditures, including, most notably, the repeated overestimation of project staff salaries,
- erroneous assignment of tasks to industrial research and development categories,
- unclear cost eligibility rules for beneficiaries,
- inclusion in applications of unjustified expenses incompatible with the purpose of the project,
- lack of understanding of the idea and principles of cooperation between the entrepreneur and the R&D sector,
- requirement to develop complex financial models based on projections of future projected revenues,

- lack of qualified personnel, including qualified personnel to implement intelligent management systems in SMEs,
- difficulties in implementing intelligent management solutions in the process of energy transformation of the organization and the realization of sustainable development goals,
- low quality of services of consulting companies supporting the SME sector in obtaining grants,
- lack of proof of the presented model of the volume of planned sales of products/services of projects – declarative nature of assumed sales volumes, i.e. not supported by verifiable data, market analysis, market research or letters of intent from potential customers.

The possibility for SMEs to obtain support for the development and implementation of innovative products/services under nationwide competitions organized by PARP as an intermediary institution is only one of the ways to obtain EU funds under the 2021–2027 perspective. It should also be mentioned that Polish SMEs also have the opportunity to obtain European funds from, among others, the National Reconstruction Programme, as well as under sixteen Regional Operational Programs in accordance with the guidelines of individual competitions.

## 5. DISCUSSION

According to the International Monetary Fund (IMF), the world's largest economies in 2024 are still the US, China, India. The counterweight to these big economies in such a politically and economically turbulent world should be the economy of the European Union. However, this is not the case. An analysis of a range of economic data shows that Europe is growing too slowly in the 21st century, and its economy is not keeping up with its global rivals (Bavoso, 2024; Gonzalez Minguez, 2024). This is one of the conclusions of the Draghi Report (Draghi, 2024) commissioned by the European Commission. The main reason is the weak growth of productivity - that is, the ability of a worker to create added value. The analysis presented clearly shows that the European Union economy is no longer competitive with the United States and China. Without big investments, it faces “slow agony”. Constructive conclusions of the report indicate that in order to restore the EU's competitiveness, action is needed in three areas: (1) developing innovative solutions on the basis of mature technologies; (2) coupling climate goals with the development of European industry; (3) investing in security and making Europe less dependent on global partners. It has been estimated that an additional 750 to 800 billion euros per year are needed to meet these goals.

Europe's lack of growth potential is particularly pronounced in the area of innovative technologies. As much as 61% of total global funding for artificial intelligence ventures goes to US companies, 17% to Chinese companies. Only 6% of capital is raised by companies in the EU. The new plan for sustainable growth and competitiveness of the EU economy is the so-called “Competitiveness Compass for the UE” (2025) presented in January 2025 by the European Commission. It specifies that the key to competitiveness is to increase innovation by:

- creating an environment that enables young companies to start up and grow, through the EU's strategy for start-ups and scale-ups,
- helping large companies implement new technologies, such as artificial intelligence (AI) and robotics, through the strategy on the application of AI,
- making it easier for companies to do business across the Union by simplifying rules and regulations, including through the proposed so-called 28th legal system, which will guarantee one set of rules across the EU,
- supporting the development of new technologies through action plans for advanced materials, quantum technologies, biotechnology, robotics and space technologies.

One of the key barriers to the development of digital innovation in companies is the gap in good examples and their applications that could be benchmarked. In particular, this includes the implementation of smart roving solutions, including AI in the process of managing the energy transition and achieving the sustainable development goals. A benchmarking strategy is a process in which an organization compares its processes, products, services or results with the best practices and performance of other companies, usually leaders in a particular industry. The goal of benchmarking is to identify areas that can be improved and implement solutions that will help the organization gain a

competitive advantage. That is why it is so valuable to observe how companies in the European Union, especially Italian, Polish and Spanish entrepreneurs, will use the funds under PO1. Digital transformation projects and the use of AI to build competitive advantages will obviously be key in this regard.

In an increasingly globalized world economy, there is a widening gap that Europe is losing to digital powers like the US and China. Digital skills and innovation are key to creating a competitive economy as well as the prosperity, security and resilience of society as a whole. According to the European Commission, the Road to the Digital Decade Program, with specific goals and targets for 2030, is designed to strengthen the EU's digital leadership and, to that end, promote inclusive and sustainable digital policies serving citizens and businesses. To this end, specific digital goals have been set for the EU and its member states to achieve by the end of the decade in 4 areas: (1) strengthening digital skills and digital education; (2) secure and sustainable digital infrastructures; (3) digital transformation of businesses; (3) digitization of public services.

A new feature of the program is the introduction of a form of cooperative governance between member states and the Commission, so that the Union pursues its goals together. It creates favorable conditions for the development of cooperation among member states in the development of digital capabilities and technologies. The overarching goal is digital transformation that empowers citizens and businesses, in line with EU values. In the communication "Digital Compass for 2030: Europe's path in the digital decade" on March 9, 2021, the Commission outlined a vision for the EU's successful digital transformation by 2030. It shows that the EU is striving for digital sovereignty in an open and interconnected world, and wants to pursue digital policies that ensure a human-centered, inclusive, sustainable and prosperous digital future for citizens and businesses.

In Poland, the problem of digital exclusion and low-quality IT infrastructure affects many SME entrepreneurs. Their competitiveness to date has been created on the basis of advantages related to low labor costs. According to PARP's data, in 2022 only 13.2% of Polish companies were engaged in innovative activities, and 86.8% were classified as non-innovative companies. The percentage of companies introducing product or service innovations was 7.0%. As for business process innovations, the percentage of companies implementing them was 12.6%, of which only 1.9% of companies implemented IT innovations. An analysis of the scope of innovations implemented shows that in the case of product innovations, 51.0% of them involved enterprise-scale innovations and only 7.4% involved global innovations. In terms of service innovations, as much as 80.2% concerned innovations on an enterprise scale and only 4.7% were innovations on a global scale. To a small extent, these entities implemented digitization activities, which puts them at a competitive disadvantage. This clearly indicates a deficit in building international competitiveness based on innovative products and services, which is characteristic of the Polish business sector.

According to the "Policy for the Development of Artificial Intelligence in Poland" from 2020, the key sectors in which artificial intelligence will be developed are public administration, construction (with a focus on smart building), cyber security, energy, trade and marketing, medicine, industry, agriculture, and transportation and logistics. These sectors stand to benefit 2.65% of GDP after implementing AI-based solutions. In order for this to become a reality, further development of the information and communication technology (ICT) sector enterprises that are the foundation of the digital transformation of the Polish economy is essential.

Small and medium-sized enterprises account for 99.8% of all enterprises in Poland. Surveys conducted indicate that organizations of this type are characterized by low maturity in implementing solutions based on new technologies. Therefore, it is necessary to support these entities in achieving a high level of digitization, including extensive use of AI in their operations. This is to be served by a pilot program to support the implementation of artificial intelligence solutions in SMEs (Drozdowicz & Węclawska, 2024). One of the key goals of the program is to increase the use of artificial intelligence by businesses in Poland from the current level of 2.89% to 10% in 2030, which is particularly important in the context of the relatively low level of digitization of the Polish SME sector.

Observations of the SME sector in Poland indicate that entrepreneurs are trying to invest in areas related to digital technologies, but these activities are mainly limited to implementing basic digital solutions at the enterprise level. Few companies choose to implement intelligent management systems. This is especially true for smaller organizations. There is a distinct lack of action on smart management for sustainable development.

Between 2020 and 2024, the percentage of enterprises with broadband Internet access nationwide exceeded 98%. The high level of the indicator testifies to the unflagging interest in the benefits of being able to connect to the global network. Among large enterprises, the value oscillated around 100%. In 2023, among EU member states, the highest percentage of employees with access to the Internet for business purposes occurred in Sweden (86.8%), while the smallest – in Bulgaria (39.7%). Poland with the value of the indicator 55.3% was below the EU average of 61.3% (Społeczeństwo Informacyjne, 2024).

The implementation of digital technologies in the SME sector in Poland is not integrated. It usually concerns selected aspects of the business, such as accounting, human resources, and warehouse management. Therefore, it is of an operational rather than strategic nature from the point of view of creating competitive advantages. The lack of integrated information systems means that information that is extremely important from the point of view of economic activity is scattered, and its analysis is difficult or even impossible. Insufficient digitization of processes does not allow them to be mapped and systematized, which makes it impossible to identify areas that should be optimized. This also prevents the implementation of AI-based digital innovations. Artificial intelligence implemented at the enterprise level is based on the high-quality data with which it is fed. The foundation of the AI model is high-volume and continuously collected and processed data.

## 6. CONCLUSION

The European Union is aware of the importance of digital transformation using AI artificial intelligence to build and enhance the competitiveness of economies across the organization. As a result, more and more funding has been allocated to innovation development in successive financial perspectives. Cohesion policy allocated EUR 26 billion for this purpose in 2000-2006 and nearly EUR 138 billion in the current programming period 2021–2027. Currently, the indicated funding is allocated to: developing and enhancing research and innovation capacities and the uptake of advanced technologies, enhancing sustainable growth and competitiveness of SMEs, improving digital connectivity and developing digital competencies.

The implementation of these goals is taking place within the framework of the European program “Smarter Europe,” which is focused on digital transformation in the member countries in the broadest sense. We will be able to assess the effects of this program in a few years. However, it is already clear that in some sectors of the EU, innovation development activities must accelerate, for example, in the defense sector.

The paper makes a rather broad characterization of the SME sector and the level of innovation of one of the EU member countries. Poland was chosen because of the low level of innovativeness of its economy and the second largest budget in the EU for the implementation of the Smarter Europe PO1 program.

The structure of the enterprise sector in Poland indicates that SMEs should be considered the foundation of the Polish economy and a key catalyst from the point of view of the digital transformation of the Polish economy. A characteristic feature of the Polish economy is the percentage of microenterprises in the economy that is higher than the EU average. They also employ more people than the EU average. That is why it is so important to create conditions for the development of the competitiveness of these enterprises. Considering the low innovativeness of the entire Polish economy, it is necessary to take quick actions to change this state.

Actions taken in the field of digitization and innovation of the SME sector can quickly translate into Poland's competitive position, both in the business and social dimension. Thanks to digital transformation, small and medium-sized enterprises will be more open to new challenges and focused on searching for market advantages. However, the barrier to digital transformation is the undercapitalization of SME sector enterprises and the lack of specialized staff. This means that increasingly higher requirements in the field of innovation and digital technologies can be an opportunity and a threat to this market sector, determining the level of its current and future competitiveness.

The conducted research allowed to identify a number of barriers faced by SMEs in Poland. This concerns primarily difficulties in obtaining support from EU funds for the implementation of innovative

projects. This affects difficulties in creating innovative products and services on a national scale. Enterprises from the SME sector also have difficulties in indicating sources of coverage of the required own contribution. The situation on the labor market does not allow for obtaining specialists in the implementation of innovative projects, including digital ones. Low competences of project management staff mean that a significant number of entrepreneurs have problems understanding project documentation, distinguishing product innovation from process innovation, etc. In the authors' opinion, this is one of the reasons why the vast majority of application forms are prepared incorrectly. They contain numerous substantive errors and are usually characterized by low innovativeness of the proposed solutions.

New digital technologies, especially artificial intelligence and the Internet of Things, are currently treated as an important condition for strategic management of strategic importance, redefining business models, management processes or ways of using available resources. The speed of technological changes introduced, and the rationality of their implementation are becoming a determinant of the digital maturity of future business, in which humans and technologies will cooperate naturally. Digital excellence is not reduced to the implementation of subsequent solutions based on digital technologies. It is a catalyst for redefining those values that constitute the market advantage of an enterprise. Leading to the reconceptualization of methods and tools for competing in a globalized world.

The research also shows that issues related to the development of SMEs in the field of using new digital technologies have not been researched and verified to the extent allowing for their detailed assessment. The collected statistical data is scattered, and their processing is handled by a number of institutions. Available studies and analyses indicate that, compared to the European Union, Polish enterprises from the SME sector still face many challenges in the area of digital development.

The authors are aware of the study's limitations and implications. First, various data sources were used, which meant that the data were not always homogeneous. In addition, it was a problem to maintain a single time period of research for all aspects discussed, but efforts were made to include the most recent data. Secondly, the subject matter undertaken is very broad, so it was not possible to discuss all aspects more extensively. Thirdly, a limitation of the implication of the results may be the broader analysis and characterization of the level of innovation of only one EU member state, i.e. Poland, which may cause problems in generalizing the results of the research. However, the authors' own experience in terms of evaluating SME projects for EU funding in the implementation of digital transformation as well as expert insights into the problems associated with the process of digital and innovative transformation of the Polish economy, which makes some of the research results original, which is the value of this work.

**Funding:** Co-financed by the Minister of Science under the “Regional Excellence Initiative”.



Ministry of Science and Higher Education  
Republic of Poland

## REFERENCES

- Abu-Alfoul, M. N. (2023). Unlocking the Potential of ChatGPT in Economic and Finance Studies: A Game-Changing Case Study. *Social and Economic Studies within the Framework of Emerging Global Developments*, 3, 79.
- Aslam, U., & Martha, F. (2024). Transforming SME Operations with AI: Leveraging Computer Vision for Inventory Management and Quality Assurance. Retrieved from: [https://www.researchgate.net/profile/Freya-Martha/publication/386392877\\_Transforming\\_SME\\_Operations\\_with\\_AI\\_Leveraging\\_Computer\\_Vision\\_for\\_Inventory\\_Management\\_and\\_Quality\\_Assurance/links/6750162f876bd177783b2a9f/Transforming-SME-Operations-with-AI-Leveraging-Computer-Vision-for-Inventory-Management-and-Quality-Assurance.pdf](https://www.researchgate.net/profile/Freya-Martha/publication/386392877_Transforming_SME_Operations_with_AI_Leveraging_Computer_Vision_for_Inventory_Management_and_Quality_Assurance/links/6750162f876bd177783b2a9f/Transforming-SME-Operations-with-AI-Leveraging-Computer-Vision-for-Inventory-Management-and-Quality-Assurance.pdf) (03.02.2025).

- Ayinde, L., Wibowo, M. P., Ravuri, B., & Emdad, F. B. (2023). ChatGPT as an important tool in organizational management: A review of the literature. *Business Information Review*, 40(3), 137–149. <https://doi.org/10.1177/02663821231187991>.
- Bashan, A., & Kordova, S. (2021). Globalization, quality and systems thinking: Integrating global quality Management and a systems view. *Heliyon*, 7(2). Retrieved from: [https://www.cell.com/heliyon/fulltext/S2405-8440\(21\)00266-8](https://www.cell.com/heliyon/fulltext/S2405-8440(21)00266-8) (12.02.2025).
- Bavoso, V. (2024). The Quest for European Competitiveness, the Draghi Report, and the Chimera of EU-wide Capital Markets. Available at SSRN. Retrieved from: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=5015148](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5015148) (12.02.2025).
- Bostrom, N. (2020). Ethical issues in advanced artificial intelligence. *Machine Ethics and Robot Ethics*, 69–75.
- Buiten, M. C. (2019). Towards intelligent regulation of artificial intelligence. *European Journal of Risk Regulation*, 10(1), 41–59.
- Cao, Y., & Zhai, J. (2022). A survey of AI in finance. *Journal of Chinese Economic and Business Studies*, 20(2), 125–137. <https://doi.org/10.1080/14765284.2022.2077632>.
- Chen, B., Wu, Z., & Zhao, R. (2023). From fiction to fact: The growing role of generative AI in business and finance. *Journal of Chinese Economic and Business Studies*, 21(4), 471–496. <https://doi.org/10.1080/14765284.2023.2245279>.
- Coelho, P., Bessa, C., Landeck, J., & Silva, C. (2023). Industry 5.0: The arising of a concept. *Procedia Computer Science*, 217, 1137–1144.
- Competitiveness Compass for the EU. (2025). Retrieved from: [https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34\\_en](https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34_en) (12.02.2025).
- Council of the European Union. (2021). *Multiannual financial framework 2021–2027 and Next Generation EU*. Retrieved from: <https://www.consilium.europa.eu/en/infographics/mff2021-2027-engeu-final> (12.02.2025).
- Draghi, M. (2024). *The future of European Competitiveness: In-depth analysis and recommendations*. European Commission.
- Drozdowicz, K., & Węclawska, D. (2024). *Pilotażowy program wsparcia wdrażania rozwiązań sztucznej inteligencji w MŚP*. Retrieved from: [https://www.parp.gov.pl/storage/publications/pdf/Raport-koncowy-z-procesu-AI-w-MSP.DAS-27\\_02\\_2025.pdf](https://www.parp.gov.pl/storage/publications/pdf/Raport-koncowy-z-procesu-AI-w-MSP.DAS-27_02_2025.pdf) (10.03.2025).
- Dutt, D., Beena, A., & Perricos, C. (2024). *Now decides next: Insights from the leading edge of generative AI adoption*. Deloitte's State of Generative AI in the Enterprise Quarter One Report.
- Gadde, H. (2024). AI-Augmented Database Management Systems for Real-Time Data Analytics. *Revista de Inteligencia Artificial En Medicina*, 15(1), 616–649.
- Giuggioli, G., & Pellegrini, M. M. (2023). Artificial intelligence as an enabler for entrepreneurs: A systematic literature review and an agenda for future research. *International Journal of Entrepreneurial Behavior & Research*, 29(4), 816–837.
- Gonzalez Minguez, J. M. (2024). The Letta report: A set of proposals for revitalising the European economy. Banco de Espana Occasional Paper, 2430. Retrieved from: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=5030265](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5030265) (12.02.2025).
- Goujon, A., Rosin, F., Magnani, F., Lamouri, S., Pellerin, R., & Joblot, L. (2024). Industry 5.0 use cases development framework. *International Journal of Production Research*, 62(17), 6064–6089. <https://doi.org/10.1080/00207543.2024.2307505>.
- Grabowska, S., Saniuk, S., & Gajdzik, B. (2022). Industry 5.0: Improving humanization and sustainability of Industry 4.0. *Scientometrics*, 127(6), 3117–3144. <https://doi.org/10.1007/s11192-022-04370-1>.
- Griesch, L., Rittelmeyer, J., & Sandkuhl, K. (2024). Towards AI as a Service for Small and Medium-Sized Enterprises (SME). In: J. P. A. Almeida, M. Kaczmarek-Heß, A. Koschmider, & H. A. Proper (Eds.), *The Practice of Enterprise Modeling* 497, 37–53. Springer Nature Switzerland. [https://doi.org/10.1007/978-3-031-48583-1\\_3](https://doi.org/10.1007/978-3-031-48583-1_3).
- Griffin, R. W. (2005). *Podstawy zarządzania organizacjami*, Wydawnictwo Naukowe PWN, Warszawa, Poland.
- Hu, K., & Hu, K. (2023). ChatGPT sets record for fastest-growing user base – Analyst note. Reuters. Accessed October, 5.
- Jiang, S., Jia, S., & Guo, H. (2024). *Internet of Things (IoT)-enabled framework for a sustainable Vaccine cold chain management system*. *Heliyon*. Retrieved from: [https://www.cell.com/heliyon/fulltext/S2405-8440\(24\)04941-7](https://www.cell.com/heliyon/fulltext/S2405-8440(24)04941-7) (12.02.2025).
- Kaur, D., Uslu, S., Rittichier, K. J., & Durresi, A. (2023). Trustworthy Artificial Intelligence: A Review. *ACM Computing Surveys*, 55(2), 1–38. <https://doi.org/10.1145/3491209>.
- Kedi, W. E., Ejimuda, C., Idemudia, C., & Ijomah, T. I. (2024). AI Chatbot integration in SME marketing platforms: Improving customer interaction and service efficiency. *International Journal of Management & Entrepreneurship Research*, 6(7), 2332–2341.

- Lagap, U., & Ghaffarian, S. (2024). Digital post-disaster risk management twinning: A review and improved conceptual framework. *International Journal of Disaster Risk Reduction*, 104629.
- Lewandowska, A. (2021). Interactions between investments in innovation and SME competitiveness in the peripheral regions. *Journal of International Studies*, 14(1), 285–307.
- Makridakis, S. (2017). The forthcoming Artificial Intelligence (AI) revolution: Its impact on society and firms. *Futures*, 90, 46–60.
- Mariani, M. M., Machado, I., & Nambisan, S. (2023). Types of innovation and artificial intelligence: A systematic quantitative literature review and research agenda. *Journal of Business Research*, 155, 113364.
- McKinsey, 2021. (2021). The state of AI in 2021. Retrieved from: <https://www.mckinsey.com/capabilities/quantumblack/our-insights/global-survey-the-state-of-ai-in-2021> (31.08.2024)
- Mendez, C., Wishlade, F., & Bachtler, J. (2013). A new dawn for cohesion policy? The emerging budget and policy directions for 2014-20. Retrieved from: <https://strathprints.strath.ac.uk/51522/> (12.02.2025).
- Międzynarodowy handel usługami Polski w 2023 roku (2024). NBP. Retrieved from: <https://nbp.pl/wp-content/uploads/2024/12/Międzynarodowy-handel-uslugami-Polski-w-2023-r.pdf> (10.02.2025).
- Mohd Suki, N. (2024). Mediating role of AI adoption between the relationship of leadership vision, change management capability, competitive pressure, trading partnerships, and SME performance. *Pakistan Journal of Commerce and Social Sciences (PJCSS)*, 18(4), 872–892.
- Morshed, M., Mahbub, S., & Akber, J. (2024). Application of Artificial Intelligence (AI) in Small and Medium Enterprise (SME) and its Future. *GSJ*, 12(11). Retrieved from: [https://www.researchgate.net/profile/MaishaMorshed/publication/386540517\\_Application\\_of\\_Artificial\\_Intelligence\\_AI\\_in\\_Small\\_and\\_Medium\\_Enterprise\\_SME\\_and\\_its\\_Future/links/6754fc05ad10b614ef363549/Application-of-Artificial-Intelligence-AI-in-Small-and-Medium-Enterprise-SME-and-its-Future.pdf](https://www.researchgate.net/profile/MaishaMorshed/publication/386540517_Application_of_Artificial_Intelligence_AI_in_Small_and_Medium_Enterprise_SME_and_its_Future/links/6754fc05ad10b614ef363549/Application-of-Artificial-Intelligence-AI-in-Small-and-Medium-Enterprise-SME-and-its-Future.pdf) (10.03.2025).
- Müller, V. C. (2021). Ethics of artificial intelligence 1. In *The Routledge social science handbook of AI*. 122–137. Retrieved from: [Routledge.https://www.taylorfrancis.com/chapters/edit/10.4324/9780429198533-9/ethics-artificial-intelligence-1-vincent-m%C3%BCller](https://www.taylorfrancis.com/chapters/edit/10.4324/9780429198533-9/ethics-artificial-intelligence-1-vincent-m%C3%BCller) (11.02.2025).
- Nahavandi, S. (2019). Industry 5.0 – A human-centric solution. *Sustainability*, 11(16), 4371.
- Polcumpally, A. T. (2024). War, hybrid war, and revolution in the military. In: *Emerging Digital Technologies and India's Security Sector*. 22–35. Routledge India. Retrieved from: <https://www.taylorfrancis.com/chapters/edit/10.4324/9781003482703-4/war-hybrid-war-revolution-military-arun-tejapolcumpally> (12.02.2025).
- Polish Ministry of Digitization. (2025). *Cyfryzacja*. etrieved from: <https://www.gov.pl/web/cyfryzacja/pierwsze-przepisy-rozporzadzenia-o-sztucznej-inteligencji-ai-act-zaczynaja-obowiazywac> (12.04.2025).
- Santalova, M., Balahanova, D., Kuizheva, S., Lesnikova, E., & Trunova, E. (2019). Effective Tools for Management of Organization. In E. G. Popkova & V. N. Ostrovskaya (Eds.), *Perspectives on the Use of New Information and Communication Technology (ICT) in the Modern Economy*, 726. 537–545. Springer International Publishing. [https://doi.org/10.1007/978-3-319-90835-9\\_63](https://doi.org/10.1007/978-3-319-90835-9_63).
- Slavic, D., Marjanovic, U., Medic, N., Simeunovic, N., & Rakic, S. (2024). The evaluation of Industry 5.0 concepts: Social network analysis approach. *Applied Sciences*, 14(3), 1291.
- Sofiyah, F. R., Dilham, A., Hutagalung, A. Q., Yulinda, N. A., Lubis, A. S., & Marpaung, J. L. (2024). The chatbot artificial intelligence as the alternative customer services strategic to improve the customer relationship management in real-time responses. *International Journal of Economics and Business Research*, 27(5), 45–58. <https://doi.org/10.1504/IJEER.2024.139810>
- Spoleczenstwo-informacyjne. (2024). GUS. Retrieved from: <https://stat.gov.pl/obszary-tematyczne/nauka-i-technika-spoleczenstwo-informacyjne/spoleczenstwo-informacyjne> (12.03.2025).
- Tyagi, A. K., Lakshmi Priya, R., Mishra, A. K., & Balamurugan, G. (2023). Industry 5.0: Potentials, Issues, Opportunities, and Challenges for Society 5.0. In A. K. Tyagi (Ed.), *Privacy Preservation of Genomic and Medical Data* (1st ed., 409–432). Wiley. <https://doi.org/10.1002/9781394213726.ch17>.
- Wagner, G., Lukyanenko, R., & Paré, G. (2022). Artificial intelligence and the conduct of literature reviews. *Journal of Information Technology*, 37(2), 209–226.
- Wang, F.-Y., Yang, J., Wang, X., Li, J., & Han, Q.-L. (2023). Chat with ChatGPT on industry 5.0: Learning and decision-making for intelligent industries. *IEEE/CAA Journal of Automatica Sinica*, 10(4), 831–834.
- Widayanti, R., & Meria, L. (2023). Business modeling innovation using artificial intelligence technology. *International Transactions on Education Technology (ITEE)*, 1(2), 95–104.
- Xenidis, R., & Senden, L. (2020). EU non-discrimination law in the era of artificial intelligence: Mapping the challenges of algorithmic discrimination. Kluwer Law International. Retrieved from: <https://cadmus.eui.eu/handle/1814/65845> (12.01.2025).
- Xu, X., Lu, Y., Vogel-Heuser, B., & Wang, L. (2021). Industry 4.0 and Industry 5.0 – Inception, conception and perception. *Journal of Manufacturing Systems*, 61, 530–535.

- Xue, J., & Guo, L. (2024). AI cold war with China? The advantage of public conversations about ethics. *GRACE: Global Review of AI Community Ethics*, 2(1). Retrieved from: <https://ojs.stanford.edu/ojs/index.php/grace/article/view/3216> (10.03.2025).
- Yavari, F., & Pilevari, N. (2020). Industry revolutions development from Industry 1.0 to Industry 5.0 in manufacturing. *Journal of Industrial Strategic Management*, 5(2), 44–63.
- Yurdagel, M., & Baycur, G. (2024). *SME Marketing Entrepreneurship in AI-Shaped Business Environments*. In *Empowering Entrepreneurial Mindsets With AI*, 139–160. IGI Global. Retrieved from: <https://www.igi-global.com/chapter/sme-marketing-entrepreneurship-in-ai-shaped-business-environments/355878> (12.02.2025).
- Zadura, P., Lapinski, J., Zakrzewski, R., & Chaber, P. (2024). *Raport o stanie sektora małych i średnich przedsiębiorstw w Polsce 2024*. Retrieved from: <https://popw.parp.gov.pl/component/publications/publication/raport-o-stanie-sektora-malych-i-srednich-przedsiębiorstw-w-polsce-2024> (12.02.2025).
- Zysk, W. (2024). Kolorowe łabędzie, innowacje, technologia. Rola nowych czynników wytwórczych. *Polish Journal for Sustainable Development*, 28(1), 241–250.