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Adaptation determinants of artificial intelligence in small and medium enterprises

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Abstract

Purpose: Small and medium enterprises (SMEs) are increasingly using artificial intelligence (AI) in their operational and strategic activities. In order to properly prepare for the processes of AI implementation and to plan the path of digital transformation using the tools it supports, enterprises need to be fully aware of the factors that determine a successful implementation of the processes. The aim of this text is to identify the key determinants related to the adaptation of AI tools and technologies in business processes and operations of SMEs.

Design/methodology/approach: In order to establish a catalog of adaptation determinants of artificial intelligence in SMEs, 24 deliberately selected academic texts indexed in the EBSCO database and published between 2021 and 2023 were analyzed. The research methods that were used are: an exploratory research approach and a single-step logical classification method, fulfilling the required criteria of exhaustiveness and separability in the selection.

Findings: Using an exploratory approach to literature research, we identified 55 different factors impacting AI adaptation in SMEs, which we divided into the following seven categories, using a logical classification method: strategy and business model, culture and attitude, resources, support, entrepreneurship and innovation, competitive position and environmental conditions.

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Research limitations/implications: The research results have theoretical and practical implications. In the theoretical aspect, they can be a starting point for searching for methods to deal with identified determinants. In a practical aspect, the identified conditions may constitute a guide for SMEs planning to implement AI tools. A research limitation may be the fact that due to the dynamic development of the technological environment of SMEs, the identified catalog of determinants is certainly not closed.
Originality/value: The added value of the conducted research mainly concerns the identification and categorization of adaptation determinants of implementing AI in SMEs, which can significantly contribute to increasing the awareness of the SMEs about the challenges they face on the path of digital transformation.

Keywords: Artificial intelligence (AI), small and medium-sized enterprises (SMEs), adaptation of AI, conditions.

JEL: O3, M15, M210

Determinanty adaptacji sztucznej inteligencji w małych i średnich przedsiębiorstwach

Streszczenie

Cel: małe i średnie przedsiębiorstwa (MŚP) coraz częściej w swoich działaniach operacyjnych i strategicznych wykorzystują sztuczną inteligencję (AI). Aby odpowiednio przygotować się do procesów wdrażania sztucznej inteligencji i zaplanować ścieżkę cyfrowej transformacji z wykorzystaniem wspieranych przez nią narzędzi, muszą być one w pełni świadome czynników, które decydują o pomyślnym wdrożeniu tych procesów. Celem niniejszego tekstu jest identyfikacja kluczowych determinantów związanych z adaptacją narzędzi i technologii AI w procesach biznesowych i operacjach MŚP.
Metodologia/podejście: w celu stworzenia katalogu determinant adaptacji sztucznej inteligencji w MŚP przeanalizowano 24 celowo dobrane, opublikowane w latach 2021–2023 i indeksowane w bazie EBSCO teksty akademickie. Zastosowane metody badawcze to: eksploracyjne podejście badawcze oraz jednoetapowa metoda klasyfikacji logicznej, spełniająca wymagane kryteria kompletności i rozłączności doboru.
Wyniki: wykorzystując eksploracyjne podejście do badań literaturowych, zidentyfikowano 55 różnych czynników wpływających na adaptację sztucznej inteligencji w MŚP, które z kolei, za pomocą metody klasyfikacji logicznej, podzielono na następujące siedem kategorii: strategia i model biznesowy, kultura i postawa, zasoby, wsparcie, przedsiębiorczość i innowacje, pozycja konkurencyjna i warunki środowiskowe.
Ograniczenia/wnioski z badań: wyniki badań mają implikacje teoretyczne i praktyczne. W aspekcie teoretycznym mogą stanowić punkt wyjścia do poszukiwania metod radzenia sobie ze zidentyfikowanymi determinantami. W aspekcie praktycznym zidentyfikowane uwarunkowania mogą stanowić wskazówkę dla MŚP planujących wdrożenie narzędzi AI. Ograniczeniem badawczym może być fakt, że ze względu na dynamiczny rozwój otoczenia technologicznego MŚP zidentyfikowany katalog determinant nie jest zamknięty.
Oryginalność/wartość: wartość dodana przeprowadzonych badań dotyczy głównie identyfikacji i kategoryzacji determinant adaptacyjnych wdrażania AI w MŚP, co może znacząco przyczynić się do zwiększenia świadomości MŚP na temat wyzwań stojących przed nimi na ścieżce cyfrowej transformacji.

Słowa kluczowe: sztuczna inteligencja (AI), małe i średnie przedsiębiorstwa (MŚP), adaptacja AI, uwarunkowania.

1. Introduction

Artificial intelligence (AI) has revolutionized many aspects of human life, including the way business is conducted. Not only large corporations, but also SMEs, which traditionally relied mainly on experience and intuition, have been intensifying the use of AI to improve their efficiency and competitive positions (Chaudhuri et al., 2023). Initially, the main application of AI was business process automation and data analytics, often understood as hyper automation (Zapata-Cantu et al., 2022). With advances in machine learning, it has become possible to use AI to analyze big data, predict market trends, make managerial decisions, mitigate risks or survey customer satisfaction (Bharadiya et al, 2023).

Current survey results indicate that 80% of consumers express interest in AI-dri.ven shopping. It demonstrates that AI can be an important factor influencing attractiveness of what commercial enterprises offer their customers (IBM, 2024). In their survey results, McKinsey & Company (2021) emphasize that AI has begun to play a key role in many areas of business, most notably in optimizing and improving processes. Answers were selected, respectively, by 27 and 22% of more than 1,800 enterprises from all over the world, of varying sizes and business profiles, applying AI in at least one functional area and using it as the main tool.

Besides improvements that the use of AI brings to enterprises, there are some controversies associated with its use in business, most notably:

– the lack of transparency of AI tools – decisions made by AI are not always understood by humans (Burrell, 2016),
– AI's lack of neutrality – decisions based on AI can be prone to inaccuracies, discriminatory outcomes or prejudicial biases, which makes AI a source of potentially misleading information (Danks & London, 2017),
– violations of data privacy rights – private companies using AI software to make decisions about, for example, health and medicine, employment, creditworthiness or even criminal justice, do not need to secure the data they collect by encoding it (such infrastructure is expensive), which raises ethical concerns about the unauthorized use of sensitive data (Pasquale, 2015).

Despite potential difficulties in implementing and using AI, there is a huge interest in the systems. According to Deloitte, the level of investment in AI will exceed USD 6.4 billion by 2025, while PwC claims that the widespread implementation of AI will bring about a 14% increase in global GDP by 2030 (World Bank, 2021). It may be necessary for not only large corporations but also SMEs to follow the trend. For this group of enterprises, it may prove to be a major challenge due to their resource constraints or lack of experience in using such advanced technology. It is therefore important to identify potential opportunities and threats arising from using AI in management (KPMG, 2023).

The aim of the text is to identify the key determinants related to the adaptation of AI tools and technologies to the business processes and operations of SMEs. From practical point of view, focusing on the group of enterprises is particularly

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important, due to the fact that they have completely different initial situations when entering the path of digital transformation than large enterprises with the position of sector leaders, not limited by resources. Supporting SMEs in adaptation processes in the field of new technologies should therefore be the subject of extensive research exploration, hence the choice of such an area of research in this work. The results we want to achieve in the research process are in particular the diagnosis of factors that have a real impact on whether and to what extent SMEs are able to adapt to global standards of technological development.

2. Theoretical Background

2.1. Applications of AI in Management

AI has many applications in management, where it helps enterprises make decisions more efficiently, optimize and automate processes, as well as achieve better operating results (Enholm et al., 2021). AI is extremely effective in analyzing large amounts of data, especially when it comes to business data. Machine learning algorithms are able to identify complex patterns and relationships in data, which allows for more accurate predictions of future trends in their changes (Korytnicka, 2023). In management terms, it means that companies can benefit from forecasts of sales, market demand, consumer trends and other key business indicators developed by means of AI tools (Stawiarska, 2018). As a result, managers are able to make strategic decisions based on broader, more accurate analyses, adapting to changing market conditions (de Fine Licht & de Fine Licht, 2020).

AI enables predictive risk analysis by examining data from a variety of sources. Algorithms can identify potential business, financial and operational risks (Kaczmarek, 2019). Examples of applications include analyses of customer creditworthiness, assessments of market or investment risk, predictions of equipment failures or forecasts of currency trends (Haładziński, 2019). AI can analyze business operations data, identify potential risks, monitor processes and design early warning systems (Ernst & Young, 2020). With the information, enterprises can make more informed decisions and implement appropriate risk management strategies, which contributes to stability and sustainable growth (Aziz & Dowling, 2019). AI can also be used to monitor network traffic, identify anomalies or detect potential threats, thus helping to enhance cyber security (Ernst & Young, 2020).

In the area of customer relationship management, AI can significantly improve customer service quality. Machine learning algorithms analyze data on customer behavior, purchase preferences, interactions between customers and enterprises, as well as opinions of the former on the activities of the latter. Based on the information, AI-based CRM systems are able to deliver personalized offers, product recommendations and tailored marketing messages. This,

in turn, contributes to increasing customer loyalty and improving shopping experience (Chatterjee et al., 2022). AI is revolutionizing the field of marketing by enabling more effective personalization of advertising campaigns. Enterprises implementing AI can reach their target audience more effectively, increase effectiveness of advertising campaigns and build more lasting relationships with customers (Nguyen et al., 2022).

AI plays a key role in automating many routine business tasks and processes. It includes both operational and administrative tasks. For example, automation systems using chatbots can handle customer queries, which reduces waiting times and improves service effectiveness (Cui et al., 2017). In the administrative area, AI can be used to automate tasks related to documentation management, appointment scheduling or inventory monitoring (Marrella, 2019). Automating business processes translates into saving time and human resources, which allows employees to focus on more creative and strategic aspects of their work (Acemoglu & Restrepo, 2018).

With regard to human resources management, AI-based systems can help identify, organize and deliver knowledge within an enterprise. It includes managing documents and records, developing knowledge bases and sharing information among teams, which supports decision-making by structuring knowledge (Wang et al., 2022). Furthermore, AI significantly facilitates recruitment processes. Data analytics algorithms can filter huge volumes of CVs, identifying candidates' qualifications, skills and experience. AI-based recruitment systems can also assess suitability of candidates for specific positions by analyzing their employment history. In addition, during recruitment, AI-based tools such as recruitment chatbots can communicate with candidates, provide information about the company and even conduct preliminary interviews. It all speeds up the recruitment process, reduces the burden on HR staff and aids in the accurate selection of candidates (Upadhyay & Khandelwal, 2018).

AI plays a key role in logistics optimization. Based on historical data and current trends, demand predicting algorithms allow for better production planning and inventory management. AI can help dynamically adjust prices based on an analysis of market, competition and internal data. The systems can take into account various factors such as demand, seasonality or competitive strategies to modify an enterprise's pricing strategy (Yaiprasert & Hidayanto, 2024). Moreover, monitoring systems can track transportation, warehousing and deliveries, allowing the supply chain to respond to changing conditions. In the event of problems such as delays or breakdowns, AI can quickly adjust delivery plans to minimize the impact of such disturbances on the entire supply chain. This, in turn, results in increased operational efficiency, reduced costs and improved customer service through timely delivery of products (Dash et al., 2019).

In project management, AI assists in planning, monitoring and controlling the progress of work. Algorithms can analyze data about schedules, resource availability, costs and project risks. AI-based project management systems can forecast potential delays, identify areas requiring more attention and suggest

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optimization measures in a project plan (Ong & Uddin, 2020). Also, AI-based tools can facilitate communication within teams, track task progress and automate routine project management activities. It translates into increased efficiency in project execution, cost control and timely submission of deliverables (Dam et al., 2019).

In the current business environment, ethics and regulatory compliance are of paramount importance. AI-based systems can be used to monitor an enterprise's activities with respect to compliance with applicable laws, ethical standards and internal bylaws. Algorithms that analyze data can help identify potential risks of regulatory violations, corruption or fraudulent practices (Vyas, 2023). In addition, AI-based systems can help track changes in regulations and adapt organizational procedures to current requirements, thus minimizing the risk of violations and unethical actions.

AI also has numerous applications in the areas of innovation and R&D. Algorithms can analyze scientific data, technical literature, market trends and results of research and experiments. In this way, AI can support R&D processes by identifying potential areas of innovation, predicting the impact of new technologies or helping to optimize research processes (Xing et al., 2020). Especially in areas such as pharmaceuticals, biotechnology or new technologies, AI can accelerate the pace of innovation and support research ventures, which strengthens enterprises' competitiveness in the market (Kolluri et al., 2022). AI also assists in monitoring and analyzing carbon footprints made by business organizations (Pandey et al., 2022). By analyzing GHG emissions data, AI can help identify areas where changes can be made to minimize a company's environmental impact. This, in turn, increases its innovative value and compliance of its operations with legal guidelines and social trends (Cowls et al., 2021).

A good AI integration can significantly improve an enterprise's efficiency and competitiveness (Leslie, 2019). However, introducing AI into management requires caution and consideration of aspects related to data security, ethics and employees' understanding of the technology (Jarek & Mazurek, 2019).

2.2. Directions for the Implementation of AI in SMEs

In SMEs, AI systems are primarily aimed at supporting time-consuming processes traditionally performed by humans, as well as introducing innovation to enhance a company's attractiveness in the eyes of current and potential consumers. However, it is limited due to less knowledge and capital than in the case of large corporations (Bettoni et al., 2021). Previous research on the directions of AI implementation in Polish SMEs allows for the formulation of the following conclusions: (Ministry of Digitization of the Republic of Poland, 2023):

– among SMEs, investments in areas related to digital technologies are common, but purchases are mainly limited to basic equipment used for everyday tasks,
– 51.1% of companies plan to invest in digital technologies, with one in two intending to do so in the next twelve months and more than 40% in no more

than three years. Investments will focus on ensuring availability of digital solutions for day-to-day operations and the purchase of basic equipment,
- only 5.6% of SMEs are using AI and one in ten enterprises is planning to implement AI in the next three years,
- 22.5% of SMEs are using solutions related to the Internet of Things (IoT) and 14.4% are planning to implement them in the next three years,
- 67% of SMEs are using e-services and 7.6% are planning to use them in the next three years. The most common use of e-services is for communication with authorities and external customers,
- only 18.4% of SMEs have a dedicated digitization unit in their organizational structures, and around 44% of digitization-related tasks are carried out by employees as part of their standard duties,
- the SME sector does not invest significantly in the development of their employees' digital competencies, which concerns both those responsible for digitization and other specialists. Some 70% of enterprises indicate a lack of digital training,
- the main barriers to implementing digital solutions are a lack of a diagnosed need for such training and financial issues.

When talking about specific uses of AI in SMEs, automation of administrative processes is worth noting. SMEs often have limited resources that they can use to handle documentation. Introducing AI-based tools to automate documentation management processes, such as scanning, indexing and categorizing, allows for increased efficiency and the elimination of human error (Jallow et al., 2020). For many SMEs, invoice processes can be time-consuming and error-prone. AI-based systems can automate invoice processing and, consequently, enable faster billing, identification of potential irregularities and optimization of financial flows (Nóbrega et al., 2023). Finally, the introduction of AI-based tools into task management can help improve the organization of teamwork in small businesses. Automating repetitive tasks, scheduling meetings or reminding people of important deadlines contributes to more efficient management of time, resources and broadly understood logistics (Piest et al., 2021).

For small businesses with limited geographic coverage, AI can be helpful in identifying and targeting local markets. Tools that analyze local data, shopping habits and customer preferences can assist them in tailoring their commercial offers to local needs (Antonioli et al., 2010; Pelekamoyo & Libati, 2023). The use of tools to personalize advertising content allows them to better reach local communities. AI systems analyze customers' data, tailoring ads to their preferences and purchasing behavior. AI can also help analyze seasonality and local trends, allowing offers and promotions to be better adjusted to changing market conditions. It is crucial for small businesses which are often more susceptible to changes in the local environment (Kolková & Kljucnikov, 2022).

Implementing simple chatbots for customer service allows for the automation of providing answers to frequently asked questions (Selamat & Windasari, 2021).

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it minimizes waiting times for customers and enables a quick response to their needs, even with limited human resources. Chatbots can be used to provide information about products, give purchasing advice or assist customers in the decision-making process. It is an additional source of support for customers, especially if staff support is not available. Chatbots can be used to gather customer feedback and opinions. It is a valuable tool for small businesses, enabling them to quickly adapt their offers to customers' expectations and build relationships based on dialogue (Misischia et al., 2022). AI-based tools can also support negotiations with business partners by analyzing data on contract terms and suggesting optimal solutions (Renna & Argoneto, 2010). It speeds up negotiation processes and minimizes the risk of wrong decisions.

Implementing AI sales data analysis tools enables SMEs to understand customer preferences. By analyzing purchasing behavior, companies can tailor their offers to the current needs of their customers, which translates into increased customer satisfaction and loyalty, which, in turn, is particularly important for SMEs, as a considerable part of them are "traditional" businesses (Abrokwah-Larbi, 2023; Oosthuizen et al., 2021). AI-based systems can analyze sales data, identifying the products that are the most in demand. It allows enterprises to optimize their product offerings and focus on promoting the most profitable products. Reducing non-profitable assortments is critical for businesses with little capital and turnover (Jain, 2021).

AI can support human resource management by optimizing employee schedules, conducting performance analysis and organizing training activities. It enables a better utilization of human resources, especially for companies with relatively smaller numbers of employees, such as SMEs. Optimizing processes by means of AI translates into less waste in terms of time and resources (Noponen, 2019). Elimination of redundant operations and more efficient task management lead to savings that are particularly relevant for SMEs.

Implementation of AI-based e-learning platforms allows employees to access personalized training materials. Machine learning algorithms adapt the content to each employee's individual needs and learning pace. AI-based tools can support employee training through simulations and virtual reality. It allows practical skills acquisition in a safe environment, which is particularly useful in sectors where hands-on experience plays a key role. Machine learning systems can track employees' progress, tailoring training programs to their individual needs (Sayed et al., 2023). It allows continuous improvement of employees' skills in accordance with their employers' needs, and SMEs require particularly specific skills due to not only greater multitasking than in large corporations, but also more focus on self-training and limited opportunities for training beyond a specific company process (Bołkunov, 2019).

3. Research Methodology

The aim of the text was to identify the key determinants related to the adaptation of AI tools and technologies in business processes and operations of SMEs. We searched for the determinants in academic texts addressing issues related to the implementation of AI in the SME group and indexed in the EBSCO database. The database was chosen due to the fact that it is a database that integrates texts from other smaller databases in the field of economics and management. For the analysis, we included texts published between 2021 and 2023, due to the fact that a clear increase in interest in and use of AI tools could be observed in the wake of the digital transformation initiated by the pandemic crisis. The second criterion for the selection of texts for our analysis was publication in peer-reviewed journals or peer-reviewed conference proceedings. Availability of a text in the Open Access format was another selection criterion. Applying the above criteria, we finally qualified 24 scientific texts for analysis.

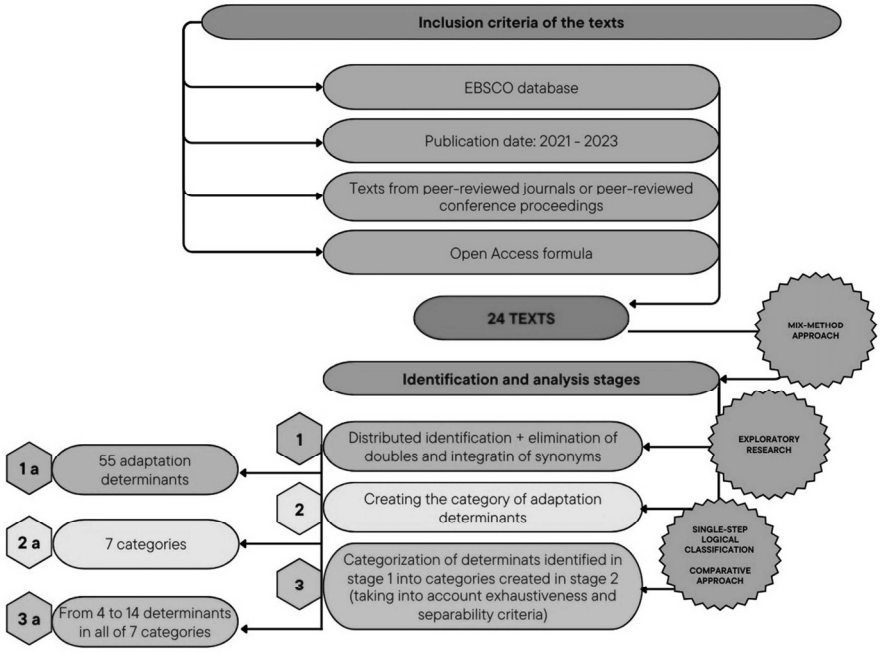
In the research process, we posed the following questions:

RQ1: What are the determinants of AI adaptation in SMEs?

RQ2: What categories can the determinants of AI adaptation in SMEs be divided into?

The research procedure is presented in detail in Figure 1.

Figure 1
Research procedure



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In the research process, we used a mix-method approach – quantitative and qualitative (Bazeley, 2008). At the first stage of the research, we performed distributed identification of adaptation determinants of AI in SMEs based on reading full texts of the publications included in the research. After selecting several dozen determinants, we removed the repetitive ones and integrated the synonymous ones, and the final result of it process was the identification of 55 different adaptation determinants. We used an exploratory research approach (Saunders et al., 2009) to identify the specific factors that constitute determinants of AI adaptation in SMEs.

In order to organize and categorize the identified determinants, we used a single-step logical classification method (Bailey, 1994; Saran, 2014). Therefore, at the second stage of the study, we created categories of adaptation determinants in accordance with the methodological rigor of the above-mentioned method, based on the content of the factor groups identified at the first stage. As a result of the process, we received 7 different categories of adaptation determinants of AI in SMEs.

At the third stage of the study, we classified the determinants identified at the first stage of the study into the categories created at the second stage, fulfilling the required criteria of exhaustiveness and separability in the selection of categories (Bailey, 1994; Saran, 2014), exhaustiveness – each determinant found an adequate substantive category; separability – each determinant fit only one category. At the stage we also used a comparative approach (Esser & Vliegenthart, 2017). As a result of the process, we created groups of adaptation determinants of AI in SMEs containing from 4 to 14 determinants in each of the 7 categories.

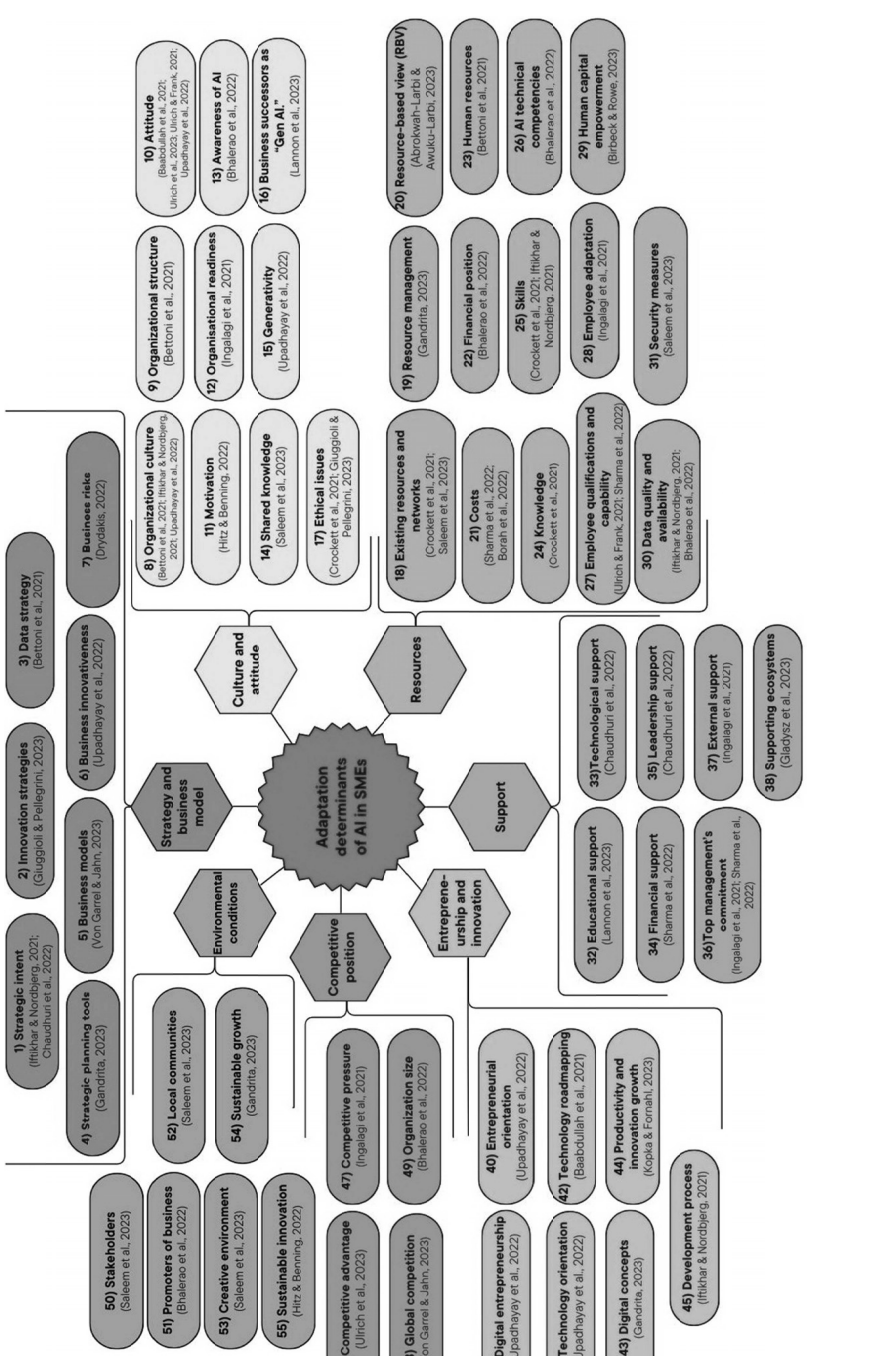
4. Results

The conducted exploratory literature review enabled us to identify 55 different factors constituting determinants of AI adaptation in SMEs. We divided the identified determinants into seven categories: 1) strategy and business model, 2) culture and attitude, 3) resources, 4) support, 5) entrepreneurship and innovation, 6) competitive position and 7) environmental conditions. All determinants broken down into the above categories are shown graphically in Figure 2.

4.1. Determinants of AI Adaptation in SMEs in the Category of “Strategy and Business Model”

One of the most important determinants of AI adaptation in SMEs is strategic intent (Iftikhar & Nordbjerg, 2021; Chaudhuri et al., 2022). It means that, in this group of enterprises, it is crucial to include AI implementation in strategic objectives before practical decision on the scope, manner and methods of integrating AI with business operations and processes are made. It mainly concerns the development of innovation strategies (Giuggioli & Pellegrini, 2023),

Figure 2
Determinants of AI adaptation in SMEs



which, in the current business environment, are not only a voluntary choice of enterprises, but also, as it were, a prerequisite for adaptation to the environment.

A data strategy is also an extremely important factor in the category (Bettoni et al., 2021), as the development of a strategy for the successful implementation of AI in the group of enterprises often requires data and information that are difficult to access and whose acquisition may involve the use of enhanced strategic planning tools (Gandrita, 2023).

Furthermore, implementation of AI tools often requires SMEs to redefine their existing business models (Von Garrel & Jahn, 2023). It is obvious that more dynamic AI implementation processes will be introduced in companies with higher levels of business innovativeness (Upadhayay et al., 2022), which does not mean that companies whose core operational activities are not oriented towards innovation do not implement AI tools. For the latter, AI tools can facilitate, for example, maintaining customer relationships or achieving marketing goals.

Business risks (Drydakis, 2022) are another important determinant of AI adaptation processes in SMEs. What is important here is not so much the mere identification of risks associated with the digitization of business operations, as the proper measurement of the probability of individual risks, the proper assessment of the impact of individual risks on business, as well as the planning and implementation of adequate preventive and corrective measures in response to the occurrence of specific risk factors.

4.2. Determinants of AI Adaptation in SMEs in the Category of "Culture and Attitude"

As it turns out, the organizational culture typical of SMEs (Bettoni et al., 2021; Iftikhar & Nordbjerg, 2021; Upadhayay et al., 2022) is a crucial element in their mental approach to the digitization of operations and thus the implementation of AI. What is relevant in the context is the attitude of both management and employees (Baabdullah et al., 2021; Ulrich et al., 2023). Scepticizm about the implementation of AI tools is very common among SMEs (Ulrich & Frank, 2021); they are less open to changes related to the process than large corporations (Upadhayay et al., 2022). For the trend to change in favor of greater openness, adequate motivation (Hitz & Benning, 2022) and organizational readiness (Ingalagi et al., 2021) are required.

The awareness of AI is also an important determinant in the category (Bhalerao et al., 2022), as skeptical attitudes are often caused by a lack of knowledge about the benefits and risks of implementation. The next factor is shared knowledge (Saleem et al., 2023), which SMEs often have problems with due to communication problems or asymmetric or over-centralized information flows.

Generativity is also important in the presented approach to AI adoption (Upadhayay et al., 2022). In this case, the biggest influence on the level of inclination towards new technologies can be exerted by the role of the business successors as "Gen AI" (Lannon et al., 2023), which is the most pronounced in family businesses.

Ethical issues constitute another determinant of the adaptation of AI tools and technologies in SMEs. Ethical considerations (Giuggioli & Pellegrini, 2023) and ethical awareness (Crockett et al., 2021) are the most relevant, as there is a high risk, especially for enterprises initiating AI implementation processes, of breaching the rules of business cooperation ethics, data protection procedures or fair competition conditions.

4.3. Determinants of AI Adaptation in SMEs in the Category of "Resources"

The existing resources and networks are among the most important internal determinants of AI adaptation in SMEs (Crockett et al., 2021; Saleem et al., 2023). However, what matters is not only the state of the existing resources or the possibility to acquire them, but also resource management (Gandrita, 2023). An emerging approach to resource management in SMEs is the resource-based view (RBV) (Abrokwah-Larbi & Awuku-Larbi, 2023).

With respect to financial resources, the most relevant determinants are the costs of AI tools, technologies and implementation procedures (Sharma et al., 2022; Borah et al., 2022), as well as the financial position of an enterprise, which condition its ability to bear such costs in a given period (Bhalerao et al., 2022).

Nevertheless, the determinants related to human resources appear to be of key importance (Bettoni et al., 2021). In this catalog, factors such as knowledge (Crockett et al., 2021), skills (Crockett et al., 2021; Iftikhar & Nordbjerg, 2021), AI technical competencies (Bhalerao et al., 2022), employee qualifications and capability (Ulrich & Frank, 2021; Sharma et al., 2022) and employee adaptation (Ingalagi et al., 2021) play a role in AI adaptation processes in SMEs. It is also worth noting that it is not only the skills already possessed by employees that are necessary for the informed use of AI tools that matter, but also support provided by managers for the development of digital competencies as part of human capital empowerment (Birbeck & Rowe, 2023).

Another group of determinants for AI implementation comprises information resources, especially data quality and availability (Iftikhar & Nordbjerg, 2021; Bhalerao et al., 2022) and technological resources, mainly the necessary security measures (Saleem et al., 2023).

4.4. Determinants of AI Adaptation in SMEs in the Category of "Support"

Support has a special role in the adaptation of AI in SMEs. The enterprises often need support on multiple levels due to the different types of constraints they have to cope with. Consequently, support for them has to be multidimensional. Educational support (Lannon et al., 2023) and technological support (Chaudhuri et al., 2022) are aimed at bridging the gaps in employees' knowledge and digital skills indispensable for the effective use of AI.

Financial support is of comparable significance (Sharma et al., 2022). SMEs not infrequently have limited resources for innovation activities or the

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implementation of new technologies, so external sources of funding for digital development are often necessary.

In this context, special attention should be paid to leadership support (Chaudhuri et al., 2022) and top management's commitment (Ingalagi et al., 2021; Sharma et al., 2022), i.e. support provided to employees by managers at various levels of business hierarchies with a view to not only developing employees' digital competencies necessary to operate AI tools, but also motivating them to adopt a positive attitude towards the technological changes being implemented.

The last, but not least, type of support is that sourced externally (Ingalagi et al., 2021) from various stakeholder groups, regulatory and supervisory institutions, experts or consultants. The most optimal way for SMEs to adapt to changes related to AI implementation is to function in supporting ecosystems (Gładysz et al., 2023).

4.5. Determinants of AI Adaptation in SMEs in the Category of "Entrepreneurship and Innovation"

The degree of entrepreneurship and innovative sophistication of SMEs represents another category of determinants of the adaptation of AI tools and technologies in their operations and core processes. The approach of SMEs to AI is certainly conditioned by their digital entrepreneurship (Upadhayay et al., 2022) and entrepreneurial orientation (Upadhayay et al., 2022).

Their technology orientation (Upadhayay et al., 2022) and technology road mapping (Baabdullah et al., 2021) also play some role. Also relevant is the fact of having properly developed digital concepts (Gandrita, 2023) that are used to enhance productivity and innovation growth (Kopka & Fornahl, 2023).

A special condition is the development process (Iftikhar & Nordbjerg, 2021) and, more specifically, what level of development, not only digital one, a small or medium enterprise is at when planning to implement AI tools into its operations.

4.6. Determinants of AI Adaptation in SMEs in the Category of "Competitive Position"

When analyzing conditions for AI adaptation in SMEs, one cannot ignore the starting position of an enterprise planning to implement new digital technologies and AI either incidentally or permanently. The factors relevant in such circumstances include an enterprise's competitive advantage (Ulrich et al., 2023) and competitive pressure (Ingalagi et al., 2021) it finds itself under.

Given the fact that an increasing proportion of SMEs are expanding to a greater or lesser extent in foreign markets or are undertaking various types of international cooperation, global competition is also important in determining the degree of readiness to implement AI tools (Von Garrel & Jahn, 2023). An organization's size also matters (Bhalerao et al., 2022), since, as a rule, larger companies abound in resources, have broader perspectives and greater capabilities that predispose them to faster and more effective digital development using AI.

4.7. Determinants of AI Adaptation in SMEs in the Category of "Environmental Conditions"

The last category of determinants of AI implementation in SMEs' business processes is environmental conditions. The importance of relationships with different stakeholder groups (Saleem et al., 2023), and especially the sustainability and iterability of such relationships, should not be overlooked. In the case of small enterprises, the so-called promoters of business constitute a particular stakeholder group capable of accelerating their technological development (Bhalerao et al., 2022).

SMEs are also generally closer, both relationally and operationally, to local communities (Saleem et al., 2023) than large corporations, which undoubtedly contributes positively to strengthening their approval of AI and preparation for its development. A creative environment also provides SMEs with conditions particularly conducive for such development (Saleem et al., 2023).

The technological climate prevailing in the immediate environment of SMEs also determines their attitude and degree of preparedness for AI implementation. Yet another influential factor is the current development trends focused on sustainability, for example sustainable growth (Gandrita, 2023) or sustainable innovation (Hitz & Benning, 2022).

5. Discussion and Conclusions

In view of the fact that artificial intelligence is now a determinant of the changing landscape for SMEs (OECD, 2021), it is necessary to diagnose the factors conditioning the processes of the adaptation of the group of enterprises to the implementation of AI-based tools and technologies, which was the objective of our study. We believe that the most important contribution of our research to both the development of the discipline of management sciences and the level of awareness of SMEs about the circumstances and conditions of their technological development is the identification of the adaptation determinants of AI, but also their categorization, it can facilitate the management processes of the enterprises and develop technological development paths adapted to their capabilities and abilities. The categories and catalog of determinants that we were able to identify constitute a comprehensive set of factors that SMEs should take into account when preparing for digital development with the use of new technologies, including AI. All the more so since the technologies can be used by them to both improve their local operations (Antonioli et al., 2010) and promote the trends of globalization adapted thanks to gradual digital transformation (Faridi & Malik, 2020; Garzoni et al., 2020).

The determinants of AI adaptation in SMEs that we identified on the basis of the conducted literature review may have important theoretical and practical implications for the group of enterprises that are implicitly resource-constrained (KPMG, 2023) and geographically limited in their development (Pelekamoyo & Libati, 2023).

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In the theoretical aspect, they can serve as a starting point for the scientific exploration of methods and tools to cope with the identified determinants, with a view to minimizing the impact of those generating negative consequences and enhancing those contributing to the development of SMEs.

In the practical aspect, the proposed catalog of the determinants firstly may serve as a guide for SMEs, especially those that are new and inexperienced, or are still at the stage of planning to gradually implement AI in various dimensions of their activities. SMEs can treat the presented determinants as key points that should be taken into account in the processes of planning digital transformation or moving to the successive stages of the process. Secondly, the compiled catalog can be used by various stakeholder groups which, wishing to undertake various forms of cooperation with SMEs in the era of dynamic digital progress, should be aware of the barriers and enablers of technological development of their potential business partners, suppliers, manufacturers, intermediaries, contractors, etc.

Our research procedure had some limitations. The fact that we adopted the availability of the analyzed works in the Open Access formula as one of the criteria for inclusion in the research may have resulted in us not having reached all the texts in which we could find other adaptation determinants of AI in SMEs. However, in our opinion, the assumption of such an inclusion criterion is justified due to the fact that in order to identify the determinants we were looking for, we had to have free access to the full-text formula of the analyzed publications. It cannot be done solely on the basis of the title of the publication or the analysis of the abstract itself. Results of our research also have some limitations – a certain limitation of the results of our study is that the proposed catalog of the determinants of AI adaptation in SMEs is certainly not closed. Such dynamic and rapid digital development as we are currently witnessing will certainly result in more and more determinants of SMEs' success in AI implementation. Therefore, we are of the opinion that, in the following years, it will be advisable to review the catalog of the identified determinants to diagnose whether its composition should be changed, which constitutes a potential important direction for further research in the area. Potential research questions that could determine the research direction concern, for example, whether SMEs are able to manage the identified adaptation determinants of AI, and if so, to what extent, whether they are adequately protected against the risks associated with it, and whether and from where and what forms of support they can expect in the process of digitally transforming their businesses. Future research should also focus on capturing the differences between the conditions for the use of AI in business that small and medium-sized enterprises must face, as compared to large enterprises or divided into different sectors. Unfortunately, comprehensive research to identify such differences is still lacking. Identification of the differences is needed because it will determine the methods of technology management and the level of innovation of different groups of enterprises.

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Declaration about the scope of AI utilization

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