Human Interaction and Emerging Technologies (IHIET 2023), Vol. 70, 2023, 118–128
https://doi.org/10.54941/ahfe1002936

Modeling and Implementing of Program Activities to Support the Implementation of New Technologies in the Small and Medium-Sized Enterprise Sector

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ABSTRACT

The article is part of a doctoral dissertation, the aim of which is to implement the Policy for the Development of Artificial Intelligence from 2020 in Poland by **modelling and implementing program activities to support the implementation of new technologies in the small and medium-sized enterprise sector** (SME), along with their cyclical monitoring and validation. The doctoral thesis assumes that the realization of the goal will be carried out through the collection and production of a set of good practices that will support and facilitate the implementation of solutions based on artificial intelligence for SME, as well as their popularization in this group, which will fill the implementation gap (lack of addressing the needs of this target group) and the research gap (description of program mechanisms addressing the problems of policy implementation). For this purpose, a platform provided by the Global Partnership on Artificial Intelligence in the form of a website is being used and adapted in Polish market, where an entrepreneur will be able to easily validate his or her level of maturity and can see what technologies are adequate for implementation in his or her enterprise. The conceptual work on the portal identified three **main challenges facing SMEs: the difficulty in finding trusted AI suppliers, the lack of knowledge in AI, and the lack of identification of business topics and strategies where AI could be implemented in the organization**. By using the portal and describing a specific way to validate suppliers, which will also be the subject of this article, SMEs can count on programmatic support in applying AI to business operations. During the implementation of this tool in Poland, the author of the publication focused on entrepreneurs who do not use technologies or the possible implementation of technologies raises many questions (for example, of a legal nature), and thus blocks the possibility of possible implementation. The article will indicate how AI solution providers are added (assessment list), how SMEs can find out their level of implementation, as well as what recommendations for changes to the portal have come from each side so as to ensure the best possible functioning of this portal in the Polish market, thus addressing the research and implementation problem of the PhD.

Keywords: Artificial intelligence, AI, Public policy implementation, Small and medium-sized enterprise, Implementing AI

INTRODUCTION

The article is part of a doctoral dissertation that aims to implement the Policy for the Development of Artificial Intelligence from 2020 in Poland through modeling and implementation of program activities to support the implementation of new technologies in the small and medium-sized enterprise (hereafter: SME) sector, along with their cyclical monitoring and validation. For this purpose, a platform provided by the Global Partnership on Artificial Intelligence[1] (hereinafter: GPAI) in the form of a website is being used and adapted to the Polish market, where entrepreneurs will be able to easily verify their level of maturity and will be able to see what technologies are adequate for implementation in their enterprise.

GPAI is an international initiative aimed at guiding the responsible development and use of artificial intelligence (hereinafter: AI) in a way that is based on human rights, inclusion, diversity and innovation, and shared democratic values. On the Polish side, the Chancellery of the Prime Minister is involved in the work of this organization, which is represented by Robert Kroplewski, who is the Plenipotentiary of the Minister of Digitization for Information Society Affairs, as well as the substantive supervisor on behalf of the employer in the implementation doctorate being carried out by the author of this article.

GPAI is working in close cooperation with the Organization for Economic Cooperation and Development (hereafter: OECD)[2], so its activities are based on the *OECD Principles on Artificial Intelligence*[3], which talk about social inclusion, sustainable development, human-centered values and equity, technical security and accountability in the use of AI. In addition, the document identifies recommendations for policymakers who are responsible for creating national policies in this area. These include investing in AI research and development, supporting the AI ecosystem, shaping a favorable policy environment, building competencies and preparing for labor market transformation, and international cooperation based on trustworthy AI. These recommendations are evident in the activities of GPAI, which has based its structure on four working groups: Responsible AI, Data Governance, Future of Work, and Innovation and Commercialization.

In the context of the following article, the most important group is the one that deals with innovation and commercialization, as it has been focusing on ways to help SMEs implement AI, thus emphasizing its importance to a country's economy. The work of this group is organized into committees, one of which is the *SME Committee*, whose activities are based on the premise that SMEs can gain a market advantage using AI as long as they overcome certain barriers. The project they are undertaking called "Widespread Adoption of AI by SMEs" focuses on identifying SMEs that are "unaware" (i.e. lack knowledge about AI) of how AI can be used as a tool to improve their business.

[1] Global Partnership on Artificial Intelligence: https://gpai.ai (accessed February 15, 2023).

[2] Organization for Economic Cooperation and Development: https://www.oecd.org (accessed 15.02.2023).

[3] Recommendation of the Council on Artificial Intelligence, OECD, 2022: https://legalinstruments.oecd.org/en/instruments/oecd-legal-0449 (accessed 15.02.2023).

The results of the *SME Committee*'s work have been presented both in the form of a report and the AI4SME web portal[4], which implements the recommendations described in the report and which is analyzed in this article. This website is being implemented in several countries, including Poland, and is based on a template provided centrally by GPAI, but it is possible to adapt it to the local context and manage the portal through a designated portal operator, which in the case of Poland is the author of this article. The main task of this portal is to connect experienced AI solution providers with enterprises in such a way that their AI implementation needs are properly addressed.

AI4SME PORTAL ASSUMPTIONS

According to the *Report on the State of the Small and Medium-Sized Enterprise Sector in Poland*, SME account for 99.8% of all enterprises in Poland, of which 97% (2.2 million) are micro-enterprises[5]. However, it is worth noting that organizations of this type are characterized by low maturity in terms of implementing solutions based on AI. This is mainly due to the lack of adequate financial, human and competence resources, as well as low awareness of the use of data in this area. According to the GPAI *SME Committee,* one of the biggest obstacles to AI adoption is getting through the initial stage, which they included: difficulty in finding trusted AI solution providers, lack of knowledge to understand AI and identify AI use cases, and lack of guidance on AI adoption strategies. Therefore, the premise of the AI4SME Portal is based on addressing these issues. The low technological advancement of AI in Poland was also one of the main reasons for the Chancellery of The Prime Minister in Poland to join the project.

A key feature of the portal is to help SME organizations provide access to resources that provide identification of the level of knowledge, as well as projects they could implement at home. Therefore, the portal provides examples of AI-based solution implementations for different sectors and different business processes. These descriptions focus specifically on the maturity level of the company, the ethics of the solution, as well as the resources that are required for a specific implementation. This is intended to help SMEs identify the right solution for their organization and a vendor they can contact for further information on a possible implementation.

The portal also has two types of surveys: the AI Maturity Index (AIMIND), designed to assess the level of maturity of SMEs in AI, and the Solution Provider Maturity Index (SPMIND), which in turn assesses the maturity of an AI solution provider and is a mandatory element before the provider and the solutions it offers are published on the site. The process just consists of the provider filling out a questionnaire and an interview with the local portal administrator. The aim is to create high-quality AI solutions whose services will comply with established ethical principles for the use of AI, such as the GPAI values and the OECD Principles on Artificial Intelligence. This allows

[4]Polish version of the AI4SME portal: https://gpaipoland.kinsta.cloud/pl/ (accessed 15.02.2023).

[5]Report on the State of the Small and Medium-Sized Enterprise Sector in Poland, Polish Agency for Enterprise Development, 2022: https://www.parp.gov.pl/storage/publications/pdf/Raport-o-stanie-sektora-maych-i-rednich-przedsibiorstw_13_10_2022.pdf (accessed 15.02.2023).

SMEs to focus on using AI to improve their business operations based on validated solutions.

AI MATURITY INDEX (AIMIND)

The AIMIND test is based on the AI Readiness Index (AIRI) from AI Singapore (AISG)[6] and the AI Maturity Assessment Tool from the Initiative for Applied AI (appliedAI)[7], and is designed to determine an SME's level of maturity in AI, and then indicate what approach a company should take when implementing such solutions. For example, a company that is not advanced in implementing AI is suggested to adopt off-the-shelf solutions rather than develop new ones tailored to the operation of the company, as is the case with advanced organizations.

This test consists of 12 questions in 5 pillars: organizational maturity, ethics and governance maturity, business value maturity data maturity and infrastructure maturity. Completing the AIMIND test helps qualify a given entrepreneur into one of four maturity categories within the framework of AI implementation, depending on the average score arising from the answers provided. The categories are: AI Unaware, AI Aware, AI Ready and AI Competent. After receiving the test result, the company that completed the test should know which AI solutions published on the site are appropriate for it. For example, AI Unaware or AI Aware companies should consider implementing off-the-shelf solutions instead of creating dedicated and greenfield solutions (see Table 1).

In addition to a company's technical capabilities, such as AI Talent, Machine Learning Infrastructure, Data Infrastructure, the AIMIND test also focuses on the level of maturity in terms of organization. This can be seen, for example, in questions about employee acceptance of AI or the existence of a culture of experimentation in the organization. Most importantly, however, the test also assesses whether the organization is ready to implement AI in terms of ethical, legal and risk-based use of such solutions (see Table 2).

Solution Provider Maturity Index (SPMIND)

The SPMIND test is the first step that an AI-based solution provider must complete, if it wants its profile and offer to be included on the site. After completing such a test, the provider is arranged for an interview with the local portal operator (in Poland, this role is played by the author of this article), at which it is confirmed whether the answers provided are true, and only after that is it given the opportunity (or not) to publish its materials on the AI4SME website.

The methodology on which the AI supplier survey was created is based on 6 pillars and 36 dimensions in these pillars, as can be seen in Table 3. A supplier, based on its response in each pillar, can receive a score of 0, 0.5 or 1. The scores for all the pillars are added up and then divided by the number of pillars, giving a final score for the supplier. This rating is given on a scale

[6] AI Readiness Index (AIRI): https://aisingapore.org/innovation/airi/ (accessed 15.02.2023).

[7] AI Maturity Assessment Tool: https://www.appliedai.de/maturity-assessment (accessed 15.02.2023).

Table 1. Four levels of maturity according to AIMIND.

	AI Unaware	AI Aware	AI Ready	AI Competent
Average score	Less than 2.5	2.5 to 3.4	3.5 to 4.5	More than 4.5
General capabilities	Might hear about AI but is unaware of applications	Savvy consumers of AI solutions. Capable of identifying use cases for AI applications	Capable of integrating pre-trained AI model into products or business processes	Capable of developing customized AI solutions for specific business needs
General characteristics	Wait for vendors to convince use cases and business value of AI	Identified potential use cases and seek AI solutions from vendors	Evaluated viability of pre-trained AI models	Developed roadmap for AI implementation
AI adoption capability	Consume ready-made, end-to-end AI solutions		Integrate pre-trained AI models and solutions for common AI applications	Develop customized AI model for unique business needs

Source: https://gpaipoland.kinsta.cloud/aimind/ (accessed 08.02.2023)

of 0 to 5, and only those companies that receive a rating above 2.5 can be qualified for the project.

The questions a provider of an AI-based solution receives are:

IMPLEMENTING THE SOLUTION IN LOCAL MARKETS

The first stage of the portal's implementation was to test it among selected target groups (SMEs and AI solution providers) in various countries. These tests lasted until September 2022 and involved countries such as France, Germany, Singapore and Poland. During this time, each portal operator customized the site (including by translating it into the local language) and engaged in sourcing SMEs and solution providers who could participate and were interested in using the project. An additional task was to get feedback so that the portal would have as much functionality as possible addressing the challenges of these groups. The next phase after field testing will be the production deployment of the portals in the participating countries, which is planned for March/April 2023.

In the case of Poland, reaching the target groups in the testing phase was done using the AI database of the DigitalPoland Foundation[8], cooperation with the Artificial Intelligence Working Group operating at the Chancellery of the Prime Minister[9], as well as through the Artificial Intelligence Portal[10].

[8] AI Database: https://aipoland.org/ai-database/ (accessed February 16, 2023).

[9] Artificial Intelligence Working Group: https://www.gov.pl/web/ai/grupa-robocza-ds-ai (accessed 16.02.2023).

[10] Artificial Intelligence Portal: https://www.gov.pl/ai (accessed February 16, 2023).

Table 2. Dimensions assessed by the AIMIND test.

Pillars	Pathways	Evaluations
Organizational readiness	Management support	Has the organization allocated resources to AI initiatives?
	AI Literacy	Can employees identify potential AI use cases and be informed consumers of AI solutions?
	AI Talent	Does the organization have the capacity to implement, integrate and maintain AI models?
	Employee acceptance of AI	Do employees trust and accept AI-based systems?
	Experimentation Culture	Does the organization have a culture of experimentation for employees to explore and develop the use of AI?
Ethics and governance readiness	AI Governance	Does the organization have the right governance model to avoid unintended harm to end users?
	AI risk control	Does the organization have an appropriate risk level classification of AI systems?
Business Value Readiness	Business Use Case	Has the organization identified relevant examples of AI implementations and evaluated their proposed value?
Data readiness	Data quality	Does the organization have processes to ensure the quality (accuracy, completeness) of the data collected?
	Reference data	Is there a single source of reliability and consistency in data format and metadata?
Data readiness	Data quality	Does the organization have processes to ensure the quality (accuracy, completeness) of the data collected?
	Reference data	Is there a single source of reliability and consistency in data format and metadata?
Infrastructure readiness	Machine learning (ML) infrastructure	Does the organization have adequate and sufficient ML infrastructure (e.g., GPU, memory) to support training and implementation of AI models?
	Data infrastructure	Does the organization use an appropriate data infrastructure (e.g., data lake) as a central data repository?

Source: https://gpaipoland.kinsta.cloud/pl/aimind/ (accessed 08.02.2023).

Table 3. Range of questions for the AI solution provider.

Pillar	Questions
Organizational and management maturity	Does the organization identify the stages of the value chain in which its offerings are incorporated?
	Do the leadership and management of the organization affected by AI projects have an AI culture and sufficient understanding of the constraints, needs, restrictions and risks associated with AI projects?
	Are all employees involved in all engineering phases necessary for AI development and implementation identified and is the organization implementing measures to ensure their skills?
	If there are digital dependencies and/or subcontractor relationships in the context of AI projects, does the organization analyze their criticality with respect to the AI project and does it provide mitigation strategies in case of failure of these dependencies and/or relationships?
Commercial maturity	Is the organization able to clearly articulate the various applications for which it intends to use its AI solutions?
	Is the organization pursuing a business strategy that is consistent with the nature of the proposed AI solution?
	Does the organization implement a development and deployment strategy tailored to the intended uses of its products/services?
	Does the organization maintain adequate links with the ecosystem?
	Is the organization registered in the trade and company registry and has it paid the taxes and social contributions due as of the date of application?
	Is the organization marketing AI solutions?
	Is the organization able to provide customer references?
Data maturity	Has the organization implemented a process to: • clearly identify the different datasets used as input and generated as output? • Know the origin of the data? • know if they are managed internally or externally? • Identify the persons responsible for the processing performed on his data?
	Can the organization explain the methods implemented to identify the needs and constraints associated with each stage of the data lifecycle?
	Does the organization implement methods to identify: • data and metadata that may cause unfairness in AI-led processing? • elements, the processing of which could be non-compliant depending on the use case?
	Does the organization implement methods to limit the model's access to data that could lead to dishonesty or unlawful processing, both in development and operational settings?
	Does the organization implement data quality monitoring processes throughout the data lifecycle?
	Does the organization's model training implement methods for disaggregating datasets in line with best practices in the field?
	Does the organization implement methods to ensure that inputs in operational conditions are similar to the data used to create the models?

(continued)

Table 3. Continued

Pillar	Questions
Ethical maturity	Does the organization conduct activities relevant to raising ethical awareness among all personnel involved in AI projects?
	Does the organization implement a risk-based approach (including risks specific to the use of AI)?
	Does it also take into account the risk to fundamental rights (social, individual impact)?
	Does the organization implement a risk-based approach that identifies the risk of injustice in production conditions?
	Does the organization implement methods to ensure that end users and those affected by AI solution products are informed of the elements that led to the production of those products? Is the information received tailored for use by these individuals?
	Does the organization implement methods to track the data that led to the output of the AI solution?
	Does the organization provide technical documentation specifying, in particular, the types of algorithms implemented, expected performance, and area of application?
	Does the organization implement strategies to ensure that stakeholders (development, usage, inspection, public, etc.) have access to the information necessary for their relationship with the AI solution?
	Does the organization implement strategies to reduce the environmental impact of its solutions?
Infrastructure maturity	Does the organization formalize the specification of the infrastructure needed at each stage of the data lifecycle? Does it take care to deploy the resources (material and human) necessary for the infrastructure to function properly at each stage?
	Does the organization formalize the specifications of the infrastructure needed at each stage of the system engineering cycle? Does it take care to deploy the resources (material and human) necessary for the infrastructure to function properly at each stage?
	Does the organization formalize the specification of the necessary infrastructure in operational terms? Has it aligned its system with the customer's infrastructure, or does it adequately inform its customers of the resources (material and human) necessary for the smooth operation of the system?
	Does the organization implement a data protection policy at each stage of the systems engineering cycle?
End-to-end maturity	Does the organization formalize the ground rules of its AI solutions by considering the needs of the target operational context (type of users, business constraints, etc.) and technical limitations?
	Does the organization formalize the necessary operations within the data engineering steps and does it create the appropriate resources (software, hardware and personnel)?
	Does the organization formalize the necessary activities in the selection and development of the AI model, and does it appoint the appropriate resources (software, hardware and personnel)?
	Has the organization formalized the steps necessary to implement a complete system and appointed the appropriate resources (software, hardware and personnel)?
	Does the organization implement a structured approach to conducting verification of AI solutions?
	Does the organization implement procedures to ensure proper use of the system, to monitor the system after implementation, and to enable maintenance activities?

Table 4. Portal usage statistics during the test phase.

Stages	France	Germany	Poland	Singapore	Total
Solution Providers					
No. of solution providers registered	24	10	13	16	63
No. of solution providers who took the SPMIND	20	8	11	13	52
No. of solution providers who did an interview	16	8	10	13	47
No. of solution provider profiles	15	4	1	9	29
No. of solution providers feedback forms submitted	6	1	1	5	13
No. of use cases uploaded	22	4	0	27	53
SME					
No. of SMEs who took the AIMIND	15	4	27	7	53
No. of SME feedback forms submitted	9	3	1	10	23

Broad Adoption of AI by SMEs Report November 2022 - GPAI Tokyo Summit https://gpai.ai/projects/innovation-and-commercialization/broad-adoption-of-AI-by-SMEs.pdf (accessed 08.02.2023).

In the end, a total of 63 AI solution providers and 53 SME companies from all countries used the portal (see Table 4)[11]. It is worth noting that in the case of Poland, the share of the SME sector is significantly higher than in the case of the other countries, which may indicate a much higher interest of this sector in the opportunities for support and competence improvement in this area.

The comments published in the summary report[12] for the four countries participating in the test phase mainly concern the technical features of the site, e.g., adding a short know-how or 1-page graphics that would inform how to use the portal; introducing a better mechanism for searching for solutions; adding a graphic section on pages describing suppliers or the solutions they offer. However, during interviews conducted by the portal operator in Poland, people using the portal indicated completely different needs. Representatives of SMEs said that it would be most beneficial for them to indicate specific follow-up activities that would be published along with the AIMIND test result, such as indicating specific solution providers adequate to their maturity level, or indicating an educational path with relevant materials (webinars, publications) on the AI4SME website.

In view of the fact that each Operator of the portal has a very large capacity to edit existing subpages and content offered to local entrepreneurs, as part

[11] Broad Adoption of AI by SMEs Report November 2022 - GPAI Tokyo Summit https://gpai.ai/projects/innovation-and-commercialization/broad-adoption-of-AI-by-SMEs.pdf (accessed 08.02.2023).

[12] Ibid.

of the implementation doctorate being carried out, one of the goals of which is to carry out programmatic activities to support the implementation of new technologies in the SME sector, it was decided to expand the portal with the paths indicated by entrepreneurs. First, it will be a sub-site containing publications on AI, which are being developed by the Artificial Intelligence Working Group. Then, with the help of this Working Group and already registered AI solution providers, a series of webinars raising awareness of AI among SMEs will be realized, which in turn will be reflected in the next tab of the *Meetings and Events* portal. The first meetings are planned for the 2nd half of 2023 (organizational work in this regard is currently underway). After the completion of these two subsections and after appropriate promotion of the portal, as well as after obtaining more registered AI solution providers, it is planned to develop appropriate development paths for each maturity level after the AIMIND test is performed.

The Prime Minister's Office is also in charge of conducting a survey of the SME sector[13], the purpose of which is to check the readiness for implementation, level of knowledge and use of new technologies (including artificial intelligence), as well as as ascertain what obstacles the sector faces in implementing such solutions. The results of this survey, which is scheduled for completion in Q2 2023, will also influence the future shape of the AI4SME portal.

CONCLUSION

The activities presented above are an attempt to generate good practices to support and facilitate the implementation of solutions based on artificial intelligence in the SME sector, as well as their popularization in this group. It is worth emphasizing that these activities are necessary not only in the Polish market, but also in the global market. Nevertheless, the sector is not thoroughly researched in this regard, and we do not know what challenges it faces and what slows down the use of new technologies. That is why international cooperation in this field and the exchange of experience between different countries is so important. These activities additionally fill the market gap (lack of addressing the needs of this target group) and the research gap (description of program mechanisms addressing policy implementation problems in the context of SMEs) not only for the Polish market, but also for the global market. Taking any action that will support the sharing of good practices in programmatic implementation of public policies is even advisable and recommended, which is why the joint implementation of projects within the framework of a global initiative, such as GPAI in this case, is scientifically very important.

[13]Public contract for the study "On the road to digital excellence" - Market research in readiness for implementation, level of knowledge and use of new technologies (artificial intelligence, Internet of things, e-services) in local government units, central administration, state-owned companies, small and medium-sized enterprises https://www.gov.pl/web/premier/pn-102022-przeprowadzenie-badania-w-drodze-ku-doskonalosci-cyfrowej--badania-rynku-w-gotowosci-wdrozenia-poziomu-wiedzy-i-wykorzystania-nowych-technologii-sztuczna-inteligencja-internet-rzeczy-e-uslugi-w-jednostkach-samorzadu-terytorialnego-administracji-centralnej-spolkach-skarbu-panstwa-malych-i-srednich-przedsiebiorstwach (accessed 16.02.2023).

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