DOCTORAL CONSORTIUM

ENHANCING AI ADOPTION IN EUROPEAN SMES: A REFERENCE MODEL FOR SECURE AND ETHICAL INTEGRATION

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The rapid advancement of artificial intelligence (AI) offers significant benefits but also poses challenges, particularly for European Small and Medium Enterprises (SMEs). The aim of this dissertation project is to develop a reference model combining simplified Enterprise Architecture (EA) and Value-Sensitive Design (VSD) to facilitate secure and ethical AI adoption in European SMEs. AI systems can enhance efficiency and reduce costs but also introduce risks such as legal issues and reputational harm. SMEs, crucial to the European economy, face barriers like limited resources and regulatory concerns. Design Science Research (DSR) shall be employed to develop a reference model tailored to SMEs' needs, addressing technical, ethical, and social considerations. By addressing these challenges, the research aims to foster innovation and enhance SMEs' competitiveness, promoting broader AI adoption across the EU.

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1 Problem Definition and Motivation

Rapid advancements in artificial intelligence (AI) have led to its widespread adoption across various sec- tors, with the potential to revolutionize industries and transform the way we live and work. However, the integration of AI technologies also brings forth potential risks and challenges that need to be effectively managed. (Cousido-Gonzalez & Palacios-Alonso, 2022, Wirtz et al., 2020, Wilner, 2018) The field of AI not only concerns the subject area of IT, but also a broad field of social and ethical subject complexes. (Jones, 2020) In this context, Butterworth argues that as AI applications become increasingly complex, unknown 'ethical surprises' are to be expected. This requires a more comprehensive consideration of possible ethical and social implications. (Butterworth, 2018)

AI systems execute complex financial transactions, flag potential terrorists using facial recognition software, and perform document reviews. (Scherer, 2015) Thus it is possible that AI decision-making systems can cause physical damage, legal risks, regulatory risks, reputational risks or operational and financial losses for organizations that are applying them. (Chiu & Lim,) As an example, an AI system that supports medical professionals may provide inaccurate diagnoses or cause a violation of privacy. (Mannes, 2020)

According to Gartner's trend report, AI is one of the top technology trends that is expected to have a significant impact on businesses and society in the coming years. (Gartner, 2023) However, despite the potential benefits of AI in efficiency gains or cost reductions, many organizations, particularly Small and Medium Enterprises (SMEs), struggle in adopting AI and achieving value. (Akoh, 2024, De Bellefonds et al., 2024, Agrawal & Vidyapeeth, 2024). In this work, the focus shall be set to European SMEs. SMEs are of particular interest as they form the backbone of the European economy, accounting for 67% of employment within the EU. (Robu, n. d.) Further actual AI adoption rates among European organizations indicate that they are still facing various challenges: Denmark 15.2 %, Finland 15.2 %, Luxembourg 14.4 %, Belgium 13.8 %, Netherlands 13.4 %, EU average 8 % (Eurostat, 2021). One of the main problems with AI adoption for EU SMEs is the lack of resources (money, personnel, time ...), expertise, and knowledge to implement and integrate AI technologies. SMEs often have limited budgets and lack the technical expertise to implement AI solutions, which can be complex and require

significant investment. Moreover, SMEs are hesitating to adopt AI due to concerns about regulatory and compliance, data privacy, and ethical issues. (Watney & Auer, 2021, Ulrich & Frank, 2021, Javier De Vicente Mohino et al., 2021)

As an IT security consultant working with SMEs, I have identified several recurring patterns and challenges that impact the ability of SMEs to adopt advanced technologies such as AI securely and effectively. These observations are: Inadequate documentation of IT systems, inadequate documentation of processes, resource constraints, and reactive rather than proactive approaches, in other words: lack of adherence to principles of Enterprise Architecture.

Several nations and organizations have already made initial efforts to support the adoption of AI by addressing potential threats and unethical use through the development of standardization and regulatory frameworks within various specifications. (Butcher & Beridze, 2019, Schmitt, 2022, Lorenz, 2020, Djeffal et al., 2022) This also applies to the European Union with its AI Act. The EU emphasizes ethical and transparent AI, (European Commission, 2018) potentially helping to build trust and confidence in this technology, which is critical for its widespread adoption. However, the ongoing efforts in regulations and guiding principles that companies must adhere to when adopting AI technology seems to increase the barriers to the adoption of AI technology for SMEs in the EU. (Malmborg & Trondal, 2021)

The EU is a fragmented market, with diverse languages, cultures, and economic traditions. (Spence, 2000) While this diversity can also be a challenge for AI adoption, European states also have many similarities in common, which could be an advantage in technology adoption. The regulatory frameworks most of the countries of Europe are increasingly governed by the EU. The EU has a common degree of intel- lectual and cultural heritage. (Spence & Perrini, 2009) This heritage might be what makes ethics so important to European policy makers. However the implementation of social and ethical responsibility by European SMEs is still a heterogeneous landscape. (Murillo & Lozano, 2006)

AI is often discussed from a regulatory or ethical standpoint, but few works target Enterprise Architecture . (Schneider et al., 2022) Scharre, Horowitz et al. recognize the potential for the leading AI provider to become the ruler of the world. (Scharre

et al., 2018) In order to accelerate European innovation and promote the rapid adoption of AI technology in Europe, an interest arises in finding out, if the AI adoption of European SMEs can be increased by providing SMEs with the tools, expertise, and knowledge to implement and integrate AI technologies.

Based on my experience working with SMEs, I postulate that SMEs need to adopt simplified Enterprise Architecture (EA) principles, combined with Value-Sensitive Design (VSD), to document IT systems and processes effectively, enabling the secure and ethical integration of AI into their operations.

2 Approaching the Problem

In order to approach the problem, the following provides an initial insight into methodologies and frame- works that could represent possible solution components. This work is to be deepened in the course of the dissertation by means of a scientific literature review in order to obtain as comprehensive an overview as possible. The aim here is to form a theoretical basis that can provide a comprehensive framework for understanding and overcoming the many challenges of introducing AI in SMEs.

In their studies 'Emotional responses to human values in technology' Görnemann and Spiekermann point out, that 'the goal of technology development should be to precisely identify the direct and indirect impacts in different areas of users' lives in order to build technology that is – in the ethical sense of the word – good for humans' (Görnemann & Spiekermann, 2022). Hofstede emphasizes the importance of prioritizing the social aspects of AI, advocating for the development of socially aware algorithms prior to the creation of intelligent ones. (Hofstede, 2019) This perspective highlights the significance of considering the social context and human factors in the design and implementation of AI technologies. This leads us to the Value Sensitive Design approach, which incorporates ethical considerations into the development of systems and ensures that the technology is in line with the moral and social values of its users. (Friedman et al., 2013) Value Sensitive Design could be crucial for AI integration in this context, as it offers a dynamic and adaptive approach that ensures the continuous alignment of AI technologies with the human workforce and the organization's needs.

Further the integration of AI technologies requires careful consideration of both technical and strategic aspects. An examination of Enterprise Architecture (EA) frameworks is essential to bridge the gap between IT execution and business strategy. (Lankhorst, 2009) EA helps organizations align their business goals, processes, data, applications and technology to operate efficiently and achieve their strategic objectives. (Kotusev, 2016) This alignment is essential for maximizing operational efficiency, fostering innovation, and maintaining competitive advantage. (Luftman & Kempaiah, 2007) EA acts as a strategic enabler for AI adoption by providing the necessary structure, governance, and security. (Saat et al., 2010) Nevertheless SMEs are facing issues in the implementation of EA frameworks due to their limited resources, simpler structures, and dynamic needs. (Bernaert et al., 2014)

To integrate AI into European SMEs operations, they need a tool set, specifically designed to meet their unique requirements, incorporating best practices derived from policy-maker guidelines, individual risk tolerance, and cultural elements of both the human workforce and the organization as a whole. This set of tools must meticulously assess each SME individually to align with regulatory standards, organizational culture, governance, risk management, and the seamless integration of human and AI capabilities. AI applications should adopt to SME's simple Business-IT alignment needs, and fit into their day to day activities.

The objective of this doctoral research is to create an artifact that represents a new reference model for AI integration within the enterprise architecture, tailored to the specific needs of European SMEs seeking to integrate AI into their operations. By considering their specific requirements, objectives, and the context of their AI adoption aspirations, SMEs can leverage the reference model to navigate the complex landscape of AI implementation. the reference model meticulously assesses each input to align with regulatory standards, organizational culture, governance, risk management, and the seamless integration of human and AI capabilities. The reference model guides SMEs through the technical, ethical and social considerations of deploying AI solutions and also ensures that the proposed strategies are practical, regulation-compliant, and tailored to enhance the SME's operational efficiency, innovation, and competitive edge. Success factors for a reference model, especially in the context of SMEs could be: Alignment with SME

needs; Ease of adoption; Scalability; Flexibility; Interdisciplinary approach; Cost-Effectiveness; Guidance on Change Management.

3 Research Objective

By researching the adoption of AI we can gain a deeper understanding about A) problems related to the governance and design of socio-technical systems (Bauer & Herder, 2009) and B) the requirements to information system development in AI integration projects (Benbya & McKelvey, 2006). Also, AI systems, particularly those that learn and improve through experience, can be seen as complex adaptive systems themselves.

The adoption of AI technologies of SMEs in Europe is an important and timely research topic. SMEs are the backbone of the European economy, accounting for over 99,8 % of all businesses in the EU and providing 64,4 % of total employment. (European Commission, 2023) However, SMEs often face significant challenges in adopting new technologies, including a lack of resources (money, personnel, time ...), expertise, and knowledge. (Ulrich & Frank, 2021, Javier De Vicente Mohino et al., 2021)

By focusing research on AI integration for SMEs in Europe, we can help to address these challenges and unlock the potential benefits of AI for this critical sector. AI has the potential to significantly improve the efficiency and competitiveness of SMEs, enabling them to automate routine tasks, make better decisions, and develop new products and services. The basis of the research inquiry lies in determining the feasibility of developing an AI adoption reference model tailored to European SMEs, with the primary goal of reducing associated challenges and risks taking into account complexity and ethics. The overall vision is to enable AI adoption and consequently foster innovation throughout the European Union.

The main research question to be answered is: To what extent can small and medium-sized enter- prises effectively adopt AI-driven innovation while ensuring legal compliance and ethical responsibility?

Based on the main research questions the following sub research question need to be answered:

1. What are the key challenges European SMEs face in adopting AI-driven innovation while maintaining legal compliance and ethical responsibility?
2. What specific requirements must an artifact for AI adoption meet to address SMEs 'constraints while ensuring compliance and ethical practices?
3. WhatcomponentsandstructureshouldtheartifactincludetoguideSMEsinsecurelyandresponsibly adopting AI technologies and how can the artifact be integrated into an SME's Enterprise Architecture?
4. How can the artifact be applied in real world SME scenarios to validate its effectiveness and practicality?
5. How effectively does the artifact address the identified challenges, and what metrics can be used to assess its success?

4 Methodology

The application of Design Science Research (DSR) methodology is planned for this dissertation. DSR is a systematic and iterative approach to problem-solving that focuses on creating and evaluating innovative solutions to complex challenges. (Chatterjee et al., 2023) DSR is ideal for research that aims to develop new frameworks, models, methods, or tools (artifacts) to address specific challenges. DSR combines rig- orous research with practical application. DSR bridges the gap between theory and practice by grounding solutions in rigorous research while ensuring they are actionable in practice. (Weigand & Johannesson, 2023) Thus DSR empowers researchers and practitioners to address real-world problems. (Hevner et al., 2004) Following the DSR principles according to Hevner, the subsequent five studies are planned for achieving the goal of the dissertation:

1. Problem understanding – What are the key challenges European SMEs face in adopting AI- driven innovation while maintaining legal compliance and ethical responsibility?

Scientific Paper 1

Title: Barriers to AI Adoption in European SMEs: A Study on Ethical and Legal Challenges

Focus: This paper identifies and categorizes the main obstacles to AI adoption in SMEs, including limited resources, compliance issues, and ethical considerations.

2. Define Artifact – What specific requirements must an artifact for AI adoption meet to address SMEs 'constraints while ensuring compliance and ethical practices?

Scientific Paper 2

Title: Defining Reference Model Requirements for Ethical and Compliant AI Adoption in SMEs

Focus: This paper outlines the objectives and design principles for a solution, considering the constraints and priorities of SMEs.

3. Design and Development – What components and structure should the artifact include to guide SMEs in securely and responsibly adopting AI technologies?

Scientific Paper 3

Title: A Tailored Reference Model for AI Integration in SMEs: Addressing Enterprise Architecture and Ethics

Focus: This paper presents the design of an Enterprise Architecture integrated reference model that aligns technological capabilities with ethical and legal requirements for SMEs.

4. Demonstration – How can the proposed artifact be applied in real world SME scenarios to validate its effectiveness and practicality?

Scientific Paper 4

Title: Application of a Reference Model for AI adoption: Case Studies in SMEs

Focus: This paper documents the implementation of the reference model, illustrating its applica- tion and practical impact.

5. Evaluation of the Artifact – How effectively does the artifact address the identified challenges, and what metrics can be used to assess its success?

Scientific Paper 5

Title: Evaluating the Impact of an AI Adoption Reference Model for SMEs: A Metrics-Based Approach

Focus: This paper evaluates the reference model using qualitative and quantitative metrics, as- sessing its ability to improve AI adoption while ensuring compliance and ethics.

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