Paradigm Academic Press
Art and Society
ISSN 2709-9830
AUG. 2025 VOL.4, NO.7

"AI Implementation Journey" of SMEs in Germany — 10 Main Obstacles

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doi:10.63593/AS.2709-9830.2025.08.005

Abstract

Small and medium-sized enterprises (SMEs) are significantly less likely to use artificial intelligence (AI) technologies than large companies. However, company size has little to no influence on companies' acceptance of AI technologies. There must therefore be barriers and obstacles that specifically prevent SMEs from using such tools. This study identifies and structures the "10 main obstacles" in the form of an "SME implementation journey" based on the current state of research and derives recommendations for action.

Keywords: artificial intelligence, SME, digital transformation

1. Introduction

Around 80% of SMEs do not yet use AI — what prevents them?

According to the Federal Statistical Office, an average of 20% of German companies used artificial intelligence (AI) in 2024, significantly more than in the previous year (12%). This figure was 48% for large companies, 28% for medium-sized companies, and only 17% for the many small companies (Destatis, 2023; Destatis, 2024). Apparently, many of these small and medium sized enterprises (SMEs) are trying to solve their AI projects solely internally rather than handing over (some) control to external service providers (Reder et al., 2018).

The current range of AI tools and technologies, which includes machine learning, robotics, and artificial neural networks among others, promises positive effects in terms of increased efficiency, innovation, risk management, and optimization of business processes in many areas (Friedl, 2019; Mehta & Senn-Kalb, 2023; Nuhiu & Aliu, 2024; Berg, 2022). In controlling, for example, the use of AI enables enterprises to create budgets that go far beyond traditional corporate planning and dynamically take market changes into account in real time (Dillerup et al., 2020; Friedl, 2019). Interestingly, company size appears to have little to no influence on companies' acceptance of AI technologies (Reder et al., 2018).

Consequently, barriers and obstacles must exist, that specifically prevent SMEs from using AI technologies. Although some studies have investigated possible causes, the results of these studies vary considerably (Destatis, 2024; Raab, 2022). The following section systematizes possible barriers and obstacles, including specific starting points for SMEs to overcome them.

Some of the most commonly used large language models (LLMs) were asked: "What specific reasons prevent small and medium-sized enterprises from using AI technologies on a larger scale?". The following Table 1 shows the results.

Table 1. LLM search for 10 main obstacles (own search from February 13, 2025)[1]

Obstacle	Large Language Model (LLM)		
	OpenAI GPT-4o	Microsoft Copilot	Google Gemini
1. Legal and regulatory framework	x		x
2. Data security	x		x
3. Objective			x
4. Skills	x	x	x
5. Teamwork and culture	x	x	x
6. Data availability and structure	x		x
7. The “right tool”			x
8. Black box risk	x		
9. Gradual implementation	x		x
10. Cost-benefit analysis	x	x	x

It is interesting to note that some of the models listed a comprehensive number of specific reasons. For better illustration, these have been transferred to the scheme of “10 main reasons” in Figure 1. However, none of the models succeeds in listing all particularly relevant reasons, let alone presenting them in a logically structured form.

Based on current studies, however, the “10 main obstacles” can be identified and logically structured in the form of an “SME implementation journey”:

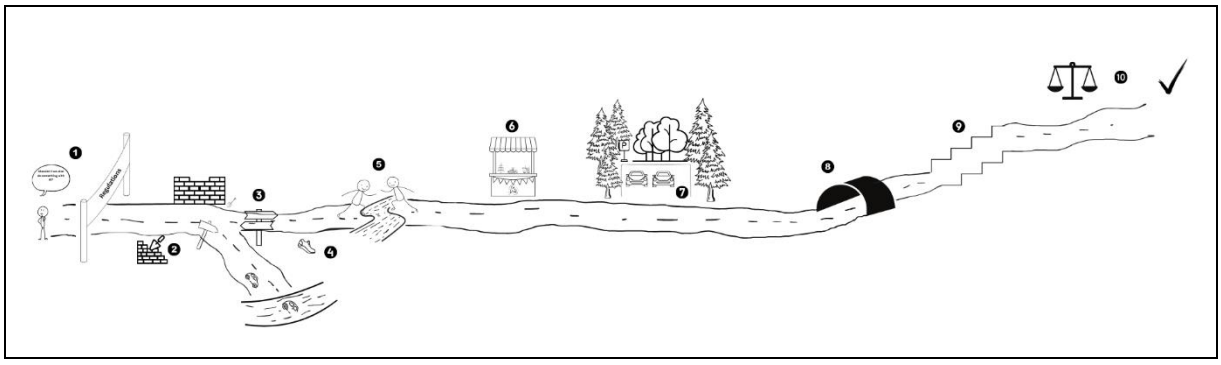

Figure 1. Implementation journey (own representation, visualization revised using Canva)

1: Legal and regulatory framework; 2: Data security; 3: Objective; 4: Skills; 5: Teamwork and culture; 6: “Provisions”: Data availability and structure; 7: Not seeing the forest for the trees — the “right” tool; 8: Black box risk; 9: Gradual implementation; 10: Cost-benefit analysis.

2. Main Obstacles

Obstacle 1 “Legal and regulatory framework” and 2 “Data security”

Over 60% of companies refrain from using AI and related technologies due to regulatory requirements and IT security concerns, among other reasons (Wintergerst, 2023a; Berg, 2022; Raab, 2022). Often, there is a lack of knowledge about how to deal with potential security vulnerabilities and how to remedy them (Reder et al., 2018). Unauthorized access and manipulation pose a direct risk in this regard. In addition, companies are often interconnected with suppliers or customers and across the value chain, which further intensifies this problem (Ottersböck et al., 2023). According to a VDE study from 2019, however, the main cause of data protection problems, including those relating to AI systems, lies in human error (VDE, 2019). Special employee training can offer significant added value here, particularly for SMEs with smaller IT departments.

[1] The shown results have to be understood as illustration and do not claim to be exhaustive. Please note that repeated use LLMs may produce different results.

The hurdle of regulation and data security affects all companies almost equally, regardless of their size (Destatis, 2024). Although this places extensive demands on companies, these risks are generally well assessable and therefor manageable. Of course, the associated costs must be fully taken into account in a cost-benefit analysis (see obstacle 10).

Obstacle 3: "Objectives"

As in all other areas, the same applies to the introduction of AI: First, the focus is on definition and clarification of your own business needs: "What do we want to achieve or improve?" Only then the market situation in terms of potential providers and technologies is to be analysed. Furthermore, a detailed examination of the company's own data situation has to be conducted (Metternich et al., 2021). Following this chronology ensures a well-founded strategic decision for a specific AI tool instead of blindly following a trend and possibly making economically irrational decisions.

Obstacle 4: "Skills" and 5: "Teamwork and culture"

Digital transformation requires new skills that employees must learn. However, the focus is less on "hard" skills such as programming or statistics but rather on "soft" skills such as interpretation with contextual knowledge, emotional intelligence and communication (Egle & Keimer, 2021; Reder et al., 2018).

In addition to empowering individuals, interdisciplinary teams can contribute significantly to success, as the criteria for successfully introducing and working with AI tools go far beyond specific technical skills (Reder et al., 2018). For SMEs, this often means reorganizing their existing organizational structure in a less line-oriented and more project-oriented or matrix-based manner. In addition, it seems necessary for many SMEs to undergo a significant cultural change toward "boldly trying out" new technologies and approaches (Reder et al., 2018). Such a cultural change could have the positive side effect of making SMEs more attractive as employers for younger generations and thereby counteracting the current shortage of skilled workers.

Obstacle 6: "Data availability and structure"

AI tools are highly dependent on the quality of the data with which they are trained. If the data is incorrect, incomplete, or outdated, the results of AI models can provide inaccurate or misleading recommendations (Braun & Follwarczny, 2021; Gläß, 2018; HORIZONT Online, 2023). Especially when real-time data analysis is used and automated decisions are made, it is almost impossible to spot and fix errors in the database retroactively (Kajüter et al., 2019). Both, high design quality (which data in which quantity etc.) and high conformity quality (up-to-date, complete etc.) are essential for good results (Heinrich & Klier, 2009; Gronau et al., 2016; Schäffer & Weber, 2016). Companies can particularly face challenges in this context, when transferring data from external sources into a usable database for AI tools (Dillerup et al, 2020).

The lack of data alone can often be a reason for companies not to use AI tools (Raab, 2022). Beyond that, the described interrelated aspects of data management often represent the decisive hurdle to the successful introduction of AI (Berger, 2024).

Obstacle 7: "The right tool"

Even if data quality is not an obstacle, it is clear that many companies do not know which technologies are required for their specific projects — also because the terms used in the field of AI are often not clearly defined (Reder et al., 2018). At this point, it can be useful to seek external assistance in navigating the rapidly developing and changing market. At least until a certain level of market maturity and consolidation has been achieved and AI providers also focus on SMEs as a potential customer group. However, it is important not to completely commit to a single technology (yet), as the market is subject to significant change (see f. ex. Klein et al., 2023; Lee & Whitaker, 2022).

Obstacle 8: "Black box risk"

The "black box risk" refers to the opacity and unclear responsibilities within an algorithm, which often occurs in the field of deep learning. That makes it difficult to interpret how AI works, as decision-making processes in self-learning systems are often not traceable (HORIZONT Online, 2023; Metha, 2023; Wigmore, 2021; Kreutzer & Sirrenberg, 2019).

There is a risk that unnoticed errors in the algorithm can lead to incorrect results, which can be particularly problematic for companies with specific accountability obligations. In addition, the software may be unintentionally biased due to its programming (Märki & Johannssen, 2020; Wigmore, 2021; Mehta, 2023). However, it is important to note that human employees also make mistakes and are not always impartial and unbiased.

One possible solution to this problem is explainable AI (XAI), which promises transparent decision-making for the black box problem (Buxmann & Schmidt, 2021; Mehta, 2023). However, this approach inevitably requires

compromises between model complexity and explainability (Mehta, 2023).

Obstacle 9: "Gradual implementation"

Pilot projects and training courses on how to use AI can help to counteract the problems described above. It is advisable to start with less complex use cases in order to get familiarized with machine learning (Manage it, 2020). The extent to which external support is used must always be weighed up on a case-by-case basis, given that the data involved is sometimes highly sensitive (Meyer & Seiz, 2020)[1].

Obstacle 10: "Cost-benefit analysis"

There is a clear upward trend in companies investing in artificial intelligence and related technologies (Meyer & Seiz, 2020). However, compared to other investments, these are often complex decision situations with potentially high investments. This is a major problem for SMEs in particular, in addition to the lack of expertise and the associated need for new, specially trained employees (Egle & Keimer, 2021). Future savings, especially in the form of personnel cost savings, are generally cited as expected payback. However, it remains to be seen whether future developments will confirm the often high expectations (Wintergerst, 2023b). For example, a 2021 study suggests that AI systems may not lead to job cuts in controlling departments, but rather to an expansion of the departments (Egle & Keimer, 2021).

Ultimately, investments in AI technologies must also exceed their costs. This basic economic principle must be kept in sight besides all the euphoria.

3. Takeaways

As with many technological innovations, it is important for all companies to take a structured approach to the topic of AI implementation. Euphoria, fear of missing out, and blind activism will not lead to success when introducing AI technologies. The implementation path outlined above, with its 10 main obstacles, can help SMEs in particular to consider important success criteria and not lose sight of economic success as a target.

As of today, many companies are trying to solve their AI projects internally for the reasons mentioned above and are not handing over control to external service providers (Reder et al., 2018). This often leads to AI implementations stalling and being postponed. However, a clear distinction should be made in which situations these reasons are valid and in which they are not. Non-profit institutions, such as universities or Fraunhofer Institutes for example, should also be considered as external consultants. This could, especially for SMEs, be a key to success, as limited economic resources and a lack of expert knowledge often put them at a disadvantage due to their size.

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[1] At this point, reference should also be made to the guidelines for the introduction of AI tools published by the German Academy of Science and Engineering (acatech) in cooperation with the Technical University of Darmstadt, which propose a three-step approach. See Metternich et al., 2021, among others.

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