



Adoption of Artificial Intelligence: Critical Success Factors in German Small and Medium-Sized Enterprises

An Analysis Using the TOE Framework

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Abstract

Title: Adoption of Artificial Intelligence: Critical Success Factors in German Small and Medium-sized Enterprises

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This thesis aims to identify and analyze the critical success factors (CSFs) for the adoption of artificial intelligence (AI) in German small and medium-sized enterprises (SMEs) using the Technology-Organization-Environment (TOE) framework. Despite their crucial role in the economy, German SMEs lag in digital transformation, necessitating a deeper understanding of AI integration challenges and enablers. The research employs a qualitative methodology, including a comprehensive literature review and semi-structured interviews with 16 experts from various industries.

The main results indicate that the availability and quality of data, technological infrastructure, and system compatibility are crucial technological success factors. On the organizational level, factors such as top management support, a culture of innovation, and readiness are critical. Last, environmental factors are regulatory and legal requirements, competition and market pressure, and ethical and moral considerations.

The limitations of this thesis include the selection of literature and interview participants, which may not comprehensively represent all stakeholders within SMEs, and the rapidly evolving nature of AI technology, meaning the findings only capture a specific moment in time.

This thesis is useful for researchers and practitioners in the fields of business management, information systems, and innovation studies. It provides a foundation for understanding the critical success factors for AI adoption in SMEs, offering valuable insights for enhancing competitiveness and innovation in these enterprises.

Keywords: Artificial Intelligence (AI), Critical Success Factors (CSF), Digital Transformation, Small and Medium-sized Enterprises (SMEs), Technology-Organization-Environmental (TOE) Framework

Resumo

Título: Adoção da Inteligência Artificial: Fatores críticos de sucesso nas pequenas e médias empresas alemãs

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Esta tese tem como objetivo identificar e analisar os fatores críticos de sucesso (CSF) para a adoção da inteligência artificial (AI) nas pequenas e médias empresas (SMEs) alemãs, utilizando a Tecnologia-Organização-Estrutura-Ambiente (TOE). Apesar do seu papel crucial na economia, as PME alemãs estão atrasadas na transformação digital, necessitando de uma compreensão mais profunda dos desafios e fatores de integração da AI. Esta investigação empregou uma metodologia qualitativa, incluindo uma revisão da literatura e entrevistas com 16 especialistas de vários sectores.

Os principais resultados indicam que a disponibilidade e a qualidade dos dados, a infraestrutura tecnológica e a compatibilidade do sistema são fatores críticos de sucesso. A nível organizacional, fatores como o apoio da gestão de topo, uma cultura de inovação e a adaptabilidade são fundamentais. Por último, os fatores ambientais são os requisitos regulamentares e legais, a concorrência e a pressão do mercado, bem como considerações éticas e morais.

As limitações desta tese incluem a seleção da literatura e dos participantes nas entrevistas, que podem não representar de forma abrangente todas as partes interessadas nas SME, e a natureza de rápida evolução da tecnologia de AI, o que significa que as conclusões apenas captam um momento específico no tempo.

Esta tese é útil para investigadores e profissionais nos domínios da gestão empresarial, dos sistemas de informação e dos estudos sobre inovação. Fornece uma base para a compreensão dos fatores críticos de sucesso para a adoção da AI nas SME, oferecendo conhecimentos valiosos para aumentar competitividade e inovação nestas empresas.

Palavras-chave: Fatores Críticos de Sucesso (CSF), Inteligência Artificial (AI), Pequenas e Médias Empresas (SME), Tecnologia-Organização-Estrutura-Ambiente (TOE), Transformação Digital

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1.0 Introduction

In today's rapidly evolving technological landscape, the introduction and integration of artificial intelligence (AI) is at the forefront of business transformation. Small and medium-sized enterprises (SMEs) in Germany in particular face the challenge of keeping pace with these technological advances to ensure their competitiveness and innovative strength. This thesis aims to identify and analyze critical success factors (CSFs) for the adoption of AI in German SMEs using the technology-organization-environment (TOE) framework as an analytical lens.

The importance of integrating AI in SMEs is underlined by current research findings and reports. Companies that use AI effectively can increase their productivity by up to 40%, improve their profitability, create new business models, and gain a significant competitive advantage in the long term (Brynjolfsson & McAfee, 2017; Chui et al., 2023b; Maslej et al., 2024). Therefore, organizations will continue to increase their AI investments in the future (Chui et al., 2023a). AI has become the tool of digital transformation and is seen as a decisive factor for the future competitiveness of companies (Brock & von Wangenheim, 2019).

According to the national strategy for AI, Germany has set itself the goal of becoming a leading AI nation (BMBF, 2024). The use of AI technologies is crucial to maintaining the international competitiveness of the German economy (Van Roy et al., 2021). This therefore also applies to SMEs, which form the backbone of the German economy and represent around 99% of all German companies (BVMV, n.d.). However, as early as 2019, the EU Parliament pointed out that SMEs are at a disadvantage due to their very specific structure and emphasized the need to support the sector in the implementation and use of AI. SMEs often have limited resources and technological expertise (Boucher, 2019).

It is therefore essential to develop a comprehensive view of the specific CSFs that German SMEs face when adopting AI. Despite all the promising opportunities for companies, the adoption rate is still in its infancy. A recent study by Schaller et al. (2023) of 6,600 German SMEs found that only 13.4% already use AI. The topic of AI integration at an organizational level is still in its early stages, even in empirical studies (Rammer et al., 2020). There is already research that focuses on general aspects of AI integration and sheds light on readiness factors (Jöhnk et al., 2021; Pumplun et al., 2019), barriers to adoption (Aarstad & Saidl, 2019; Alsheibani et al., 2019), and the potential impact of AI solutions (Knapp & Wagner, 2019;

Sallaba et al., 2020). In addition, these studies mostly look at larger companies that have already implemented AI. Therefore, the findings of the studies are helpful for concept development but do not provide a framework for how AI can be successfully implemented. For SMEs to grow with the digital transformation and successfully use AI to consolidate and, above all, further expand their strong economic position, this thesis aims to provide a comprehensive understanding of the CSFs that influence the use of AI in German SMEs. By identifying these factors, practical recommendations for the successful use of AI technologies in SMEs are to be provided to increase their competitive advantage. To achieve this, the study will answer the following research questions:

1. Which technological, organizational, and environmental critical success factors influence the introduction of artificial intelligence in German small and medium-sized enterprises?
2. How do German SMEs perceive the critical success factors to the introduction of AI and what strategies can be used to overcome these challenges?

The paper is structured as follows. This introduction is followed by a literature review. This first deals with literature on AI in general, which is then placed in the context of modern business and its implications explained. This is followed by a literature analysis of theoretical models of technology adoption. The literature review is completed with an analysis of SMEs, specifically German SMEs and their challenges. Thirdly, the methodology of the thesis is explained, and the qualitative research is presented. This part is followed by the presentation of the results. Afterwards follows a discussion of the results and the implications for research. In this 5th chapter, the conceptual model based on the research is also presented. Finally, after the conclusion, the limitations of the research are pointed out and suggestions for future research are made.

2.0 Literature Review

This chapter presents the relevant literature, establishing a foundation for this thesis.

2.1 Artificial Intelligence

The field of Artificial Intelligence (AI) has captured the collective imagination and scholarly interest in recent decades, a fascination propelled by monumental strides in computational hardware, accelerated network capabilities, an explosion in data generation, and significant

enhancements in algorithmic sophistication (Aarstad & Saidl, 2019). Despite the amount of attention given to AI, the term itself defies a clear, universally accepted definition and reflects a variety of interpretations that span a wide range of technologies and applications (Dwivedi et al., 2021). This diversity of meaning makes it necessary to carefully break down AI into its dimensions: as a scientific discipline, in terms of the technologies that underpin it, and through its capabilities. This not only clarifies the objectives and methodologies of AI but also accentuates the organizational acumen required to harness its potential (Schmidt et al., 2020).

To navigate the conceptual landscape of AI, it is imperative to deconstruct the term into its foundational elements: the ‘artificial’ and the ‘intelligent’. The essence of ‘intelligence’ encompasses the capacity for learning, reasoning, and understanding, attributes traditionally ascribed to human cognition (Lichtenthaler, 2019). ‘Artificial’, in contrast, denotes human-crafted constructs as opposed to phenomena naturally occurring (Mikalef & Gupta, 2021). Merging these concepts results in a definition of AI as the endeavor to endow machines with the ability to simulate human intelligence, an endeavor that has led to the development of systems capable of tasks previously considered the exclusive domain of the human intellect, such as language comprehension, logical reasoning ,and sophisticated problem solving (Wamba-Taguimdje et al., 2020).

There is growing evidence in scientific discourse that AI means more than mere computing power; it involves the endeavor to endow computers with human-like capabilities. This endeavor extends to the creation of intelligent agents that can interact with their environment in a way that reflects a sophisticated understanding of external inputs (Eriksson et al., 2020). Furthermore, there is a school of thought in the academic community that holds that the trademark of true AI is its capacity for autonomy - the ability to recognize, interpret, learn and act without relying on explicitly programmed instructions (Demlehner et al., 2021).

Mikalef and Gupta (2021) explain that there are two main schools of thought when exploring the various definitions of AI: The first views AI as a specialized tool designed to perform tasks that surpass human capabilities in terms of practicality or efficiency, while the second views AI as an entity that mirrors the cognitive functions inherent in human intelligence, including perception, reasoning, and learning. While these perspectives agree on the principle that AI is a complement to human capabilities, particularly in performing complex and labor-intensive tasks, they differ in their assumptions about AI's ability to fully replicate human cognition.

From today's perspective, AI encompasses systems that can simulate human cognitive processes to help with information processing and problem-solving. This view is supported by findings from McKinsey (2024), which emphasize the role of AI in augmenting human intelligence through advanced computing techniques. This broad categorization of AI systems can be divided into two different types: Strong AI and Weak AI (Panesar, 2021; Russel & Norvig, 2016). Strong AI represents the ultimate goal of theoretical endeavors in AI research and aims to develop systems that not only mimic but also embody human consciousness and the capacity for self-reflection. Such systems could learn and conclude on their own - an area that is still largely explored theoretically (Fjelland, 2020). In contrast, weak AI is limited to specific applications such as chatbots or speech recognition technologies. These systems operate within their programming limits and mimic aspects of human intelligence without possessing true consciousness (McKinsey, 2024; Russel & Norvig, 2016).

In the broad and multifaceted field of AI, machine learning (ML) and deep learning (DL) are important pillars that define current research and applications. ML, an important sub-area of AI technology, uses advances in data availability and computing capacity to enable machines to analyze data patterns autonomously, enabling predictive modeling and informed decision-making processes (Afiouni, 2019). This autonomous learning capability is an essential component of weak AI, where algorithms perform tasks without specialized programming and rely on the integrity of the data to ensure accuracy and reliability (Bishop, 2006; Mikalef & Gupta, 2021).

Taking a closer look at ML, the practice is divided into supervised, unsupervised and reinforcement learning, with each stream targeting specific use cases. In supervised learning, labeled data pairs are used for prediction tasks such as price prediction or spam detection; this application is widespread. In contrast, unsupervised learning is characterized by the detection of intrinsic patterns in data, which facilitates customer segmentation and the improvement of image processing techniques. Reinforcement learning is characterized by an approach to decision-making in which agents learn and adapt from feedback. This method is essential for the further development of robotics and the functionality of autonomous vehicles (I. Lee & Shin, 2020; Taulli, 2023).

DL, an advanced facet of ML, uses complicated, multi-layered neural networks that can recognize complex patterns in large data sets. Through the technique of backpropagation, these

networks refine their parameters, significantly increasing performance in areas such as image and speech recognition and representing a leap in the machine's ability to process unstructured data (Aggarwal, 2018; LeCun et al., 2015; Schmidhuber, 2015). Together, these technologies and methods represent the advanced landscape of AI and highlight the critical role of data quality and algorithmic refinement in advancing this field.

As a part of DL, Generative artificial intelligence (GenAI) marks a frontier in AI development that goes beyond traditional reactive data processing and proactively creates new content. Its emergence is characterized by the introduction of Generative Adversarial Networks (GANs) in 2014, an innovation by Goodfellow et al. that introduced a dynamic between two neural networks - the generator and the discriminator - to refine the authenticity of the generated results.

GenAI includes sophisticated models such as GPT and DALL-E, which, thanks to training on large datasets, can generate text and images that closely resemble human quality. These advancements offer transformative applications, from content automation to enriched predictive analytics, that drive efficiency and innovation (Baig et al., 2024).

Figure 1 below illustrates the structure of AI by showing the path from general ML to the specialized domain of AI, where Large Language Models (LLM) such as ChatGPT and Gemini, backed by GPT-4 and LaMDA, are used. It serves as a concise visual summary of the AI landscape for this thesis.

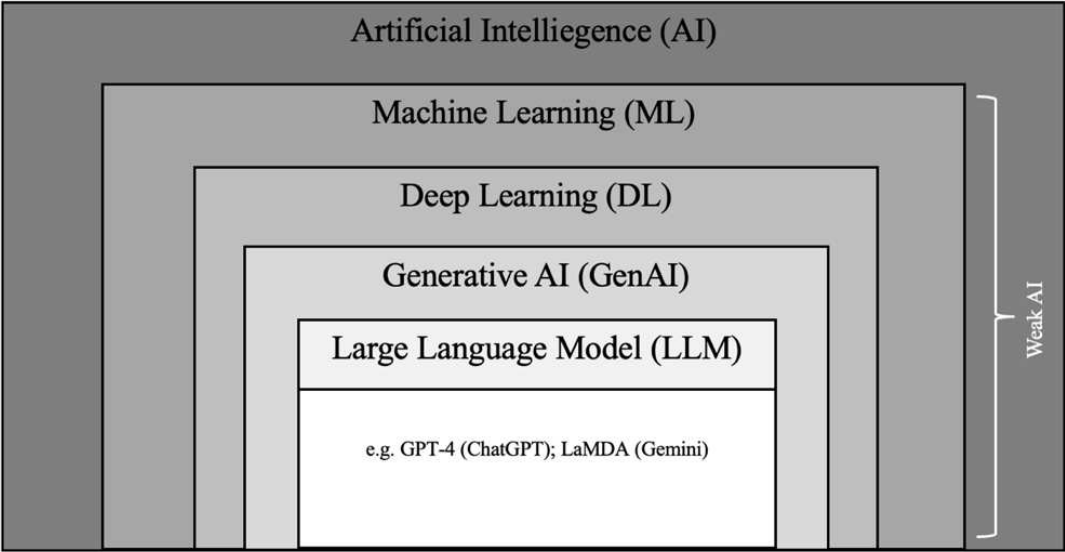


Figure 1: AI overview (following McKinsey, 2024)

2.1.1 Role of AI in Modern Business Practices

The role of AI in modern business practice is growing rapidly, as its disruptive and innovative capabilities offer numerous strategic advantages and pose various challenges for modern companies. Mastering AI technology offers a significant competitive advantage. By leveraging AI business cases and understanding the broader implications of AI integration, organizations can strategically position themselves to harness the transformative potential of AI. For example, it enables companies to optimize processes, improve decision-making, and personalize customer interactions (Brock & von Wangenheim, 2019).

AI is at the heart of digital transformation, providing powerful tools and significant opportunities to redefine operations, strategies, and competitive landscapes (BMWK, 2023). Digital transformation, as defined by Fitzgerald et al. (2014) and further elaborated by Warner and Wäger (2019), represents a significant shift in how businesses leverage digital technologies to fundamentally alter their business models, streamline operations, and enrich customer engagement. This transformation is not merely about adopting new technologies but also involves a holistic reevaluation and redesign of organizational activities, processes, and strategies to exploit the myriad opportunities presented by the digital era (Liu et al., 2011; Rogers, 2016; Singh & Hess, 2020).

One of the primary challenges in digital transformation is the need for organizations to balance the exploitation of existing capabilities with the exploration and incorporation of new, digitally enabled capabilities. This balance is critical for ensuring that firms remain competitive and relevant in an increasingly digital marketplace (Svahn et al., 2017). Warner and Wäger (2019) highlight the importance of building dynamic capabilities to navigate the complexities of digital transformation. Dynamic capabilities, comprising sensing, seizing, and transforming capabilities, are essential for firms to identify, capture, and exploit opportunities in the digital landscape (Eisenhardt & Martin, 2000; Teece, 2007).

The process of digital transformation is an ongoing journey of strategic renewal that necessitates continuous adaptation and innovation. Firms must develop the ability to sense emerging trends and opportunities, seize these opportunities through agile decision-making and rapid experimentation, and transform their organizational structures and cultures to support sustained digital innovation (Warner & Wäger, 2019). This journey involves not just the adoption of new technologies but also a fundamental shift in organizational mindset, culture,

and operations towards a more digital-oriented approach (Fitzgerald et al., 2014; Rogers, 2016; Singh & Hess, 2020). Brock and von Wangenheim (2019) found in a study that AI is often introduced and implemented as part of digital transformation projects and in a similar way to other technologies in a company.

The automation of routine tasks through AI frees up human resources for more complex work, which increases overall productivity (Autor, 2015). In addition, the integration of AI into business models promotes agility and enables companies to react quickly to market changes (Brynjolfsson & McAfee, 2017).

Following Venkatraman (2017) and Wilson and Daugherty (2018), it can generally be said that AI technologies enable performance improvements in terms of decision-making, flexibility, speed, scaling, adaptation, and innovation in organizational contexts. Studies show that AI drives innovation, facilitates data-driven strategies, and increases operational efficiency (Davenport & Ronanki, 2018).

The literature identifies the automation of processes, the extraction of insights from data for decision-making, the engagement of customers and employees, and the development and delivery of new products and services as potential ways in which AI can benefit an organization (Davenport, 2018; Davenport & Harris, 2017; Davenport & Ronanki, 2018; Lyall et al., 2018; Mikalef et al., 2019; Ransbotham et al., 2018; Schrage & Kiron, 2018; Westerman et al., 2014). The potential of AI to reduce costs, improve service quality, and productivity by coordinating various organizational processes is profound (Davenport, 2018; Iansiti & Lakhani, 2020). Its ability to create new types of human-machine configurations underscores the increasing role of AI in modern organizational structures and decision-making processes (Boden, 2018; Seidel et al., 2018). The use of AI technologies leads to a new type of agency within organizations and reflects a shift towards more autonomous, efficient, and data-driven operations (Bostrom, 2014; Canhoto & Clear, 2020).

Despite the recognized benefits, organizations often face challenges in harnessing the full potential of AI due to its complexity and the dynamic nature of its integration into existing systems and processes. The black-box nature of AI algorithms, which can be difficult for non-specialists to understand, adds another layer of complexity to its adoption (Hallinan & Striphos, 2016; Lindgren & Holmström, 2020). The black box phenomenon in AI refers to the fact that

the exact internal workings and decision-making processes of AI systems are often non-transparent and difficult to understand, even for their developers (Castelvecchi, 2016). This underscores the necessity for organizations to assess their AI readiness comprehensively, encompassing a multifaceted approach that considers technological capabilities, organizational activities, boundaries, and strategic goals (Holmström, 2022).

Furthermore, the evolution of digital technologies, including AI, necessitates a strategic reevaluation of business models, organizational structures, and processes to leverage digital opportunities fully (Fitzgerald et al., 2014; Warner & Wäger, 2019). The integration of AI into digital transformation strategies offers businesses the opportunity to innovate, enhance efficiency, and maintain competitiveness in a rapidly evolving digital environment (Ransbotham et al., 2018).

Chui et al. (2022), for example, show how versatile AI is already being used in modern companies today, presenting concrete use cases for GenAI and thus highlighting the considerable advantages it can offer companies even in the early stages of GenAI maturity (Tab. 1).

Marketing & Sales	<ul style="list-style-type: none"> • Write marketing and sales copy including text, images, and videos • Create product user guides • Analyze customer feedback • Improve sales force • Create or improve sales support chatbots
Operations	<ul style="list-style-type: none"> • Streamline customer service • Create or improve customer support chatbots • Identify production errors, anomalies, and defects • Identify clauses of interest
IT/Engineering	<ul style="list-style-type: none"> • Write code and documentation • Automatically generate or auto-complete data tables • Generate synthetic data
Risk & Legal	<ul style="list-style-type: none"> • Draft and review legal documents • Summarize and highlight changes • Answer questions from a large number of legal documents
HR	<ul style="list-style-type: none"> • Assist in creating interview questions for candidate assessment • Provide self-service HR functions
Utility/Employee Optimization	<ul style="list-style-type: none"> • Optimize communication among employees • Create business presentations • Synthesize a summary • Enable search and question-answering • Automated accounting by sorting and extracting documents

Table 1: Applications of AI in business (following Chui et al., 2022)

2.1.2 Impacts of AI for Businesses

The impact of AI on business processes and strategies has attracted considerable attention from both academics and industry leaders. The initial benefits of AI have been outlined. This section will now examine these benefits in greater detail. The literature provides a detailed analysis of these impacts and categorizes them into first-order effects, which relate to immediate changes in business processes, and second-order effects, which encompass broader changes at the company and market level. This order is based on that of Enholm et al. (2021). In the following, these multi-layered effects are examined and the transformative potential of AI in various areas is highlighted.

First-Order Impacts of AI

One of the primary impacts of AI is the enhancement of efficiency. The automation of tasks through AI not only replaces routine and repetitive human tasks with machine operations but also allows employees to engage in more value-added activities, thereby boosting overall productivity. This shift towards automation leads to increased precision, reduced error rates, and improved throughput in operations, particularly in sectors like manufacturing and supply chain management (Chui et al., 2023a; Schönberger, 2023; Schoonhoven et al., 2019).

Another first-order effect is the ability of AI to analyze large amounts of data and uncover hidden insights. These insights facilitate informed decision-making and strategic planning and enable companies to gain competitive advantage through data-driven strategies (Lichtenthaler, 2019; Mikalef & Gupta, 2021). The use of AI technologies enables companies to process and interpret data on a new scale. This can lead to an improvement in the quality of decision-making and the flexibility of the company (Chui et al., 2023a; Wamba-Taguimdje et al., 2020).

AI technologies also play a pivotal role in the transformation of business processes. By enabling the radical redesign of operational procedures, AI fosters innovation and disrupts traditional business models (Mishra & Pani, 2021). This transformation extends to organizational structures and job roles, necessitating a reevaluation of human resource utilization and the emergence of new skill requirements (Makarius et al., 2020; Wamba-Taguimdje et al., 2020).

Second-Order Impacts of AI

At the firm level, AI significantly impacts operational and financial performance. The introduction of new products and services powered by AI not only opens new market

opportunities but also enhances the quality and personalization of existing offerings (Mishra & Pani, 2020; Davenport & Ronanki, 2018). These innovations can lead to substantial revenue growth and cost efficiencies, contributing to improved financial outcomes for organizations (Alsheibani et al., 2018; Mikalef & Gupta, 2021).

The application of AI in marketing strategies enhances segmentation, targeting, and customer engagement, leading to heightened marketing effectiveness (Afiouni, 2019; Mishra & Pani, 2021). Furthermore, AI-driven personalization efforts can significantly boost customer satisfaction and loyalty, although it's essential to navigate the potential pitfalls associated with AI interactions to avoid customer dissatisfaction (Riikkinen et al., 2018; Schmidt et al., 2020).

AI's disruptive potential extends to sustainability practices, enabling organizations to pursue environmentally friendly and socially responsible business models (Toniolo et al., 2020). From reducing energy consumption to fostering circular economy strategies, AI applications contribute to sustainable development goals while addressing critical social challenges (Borges et al., 2021; Rajput & Singh, 2019).

2.2 Adoption Theories in Technological Innovation

When researching the adaptation of technological innovations, it is crucial to look at the basic theories that shed light on the dynamics of technology adoption in organizations. Kelsey and St. Amant (2008) defined technology adoption as "the stage at which a technology is mentally accepted by an individual or an organization".

One of the best-known models in literature and practice is the Technology Acceptance Model (TAM) by Fred D. Davis (1985). The model aims to create a better understanding of user acceptance and is a widely used instrument in the literature for investigating technology use in the field of information systems (IS). It emphasizes perceived usefulness and ease of use as primary predictors of technology adoption at the individual level, where perceived usefulness is defined as "the extent to which a person believes that using a particular system would improve his or her job performance", and perceived ease of use is defined as "the extent to which a person believes that using a particular system would reduce effort" (Davis, 1989). This model is primarily aimed at understanding technology adaptation at an individual level.

In the literature, two models are commonly used to analyze technology adoption at the firm level, the Diffusion of Innovations (DOI) by Rogers (1995) and the Technology-organization-environment framework (TOE) by Tornatzky and Fleischer (1990) (Chong et al., 2009). The DOI looks at how innovations spread within a community or organization over time. However, it primarily focuses on individual and social factors influencing adoption, which may not fully capture the complexities at the firm level. In contrast, the TOE framework proposed by Tornatzky and Fleischer provides a comprehensive lens for examining technology adoption, as it incorporates technological, organizational, and environmental factors, offering a more holistic view of the determinants and barriers to technology adoption in a business context.

2.2.1 Technology – Organization – Environment Framework

The TOE framework encompasses a broader range of factors, including technological, organizational, and environmental aspects. This approach recognizes that decisions related to technology adoption are not made in isolation but are influenced by a complex interplay of internal capabilities, technological characteristics, and external influences (Baker, 2011). The TOE framework has already been used in research to investigate barriers to AI implementation in SMEs (Aarstad & Saidl, 2019), to investigate determinants for the adoption of business intelligence systems in SMEs (Puklavec et al., 2014) or a comparable framework with similar elements in enterprise-level AI implementation research (Alsheibani et al., 2019; Enholm et al., 2022).

The TOE framework is as a pivotal model in understanding the multifaceted dynamics of technology adoption within organizations within the three specific levels. First, the technological context refers to the internal and external technologies relevant to the organization. This includes existing technologies the organization is currently using as well as emerging technologies that are available in the market. Second, organizational factors encompass the descriptive characteristics of an organization, such as its size, scope, resources, hierarchical structure, and decision-making processes. Third, environmental factors include the organization's industry, competitors, regulatory environment, and broader socio-economic conditions (Baker, 2012). It is illustrated in the following Figure 2.

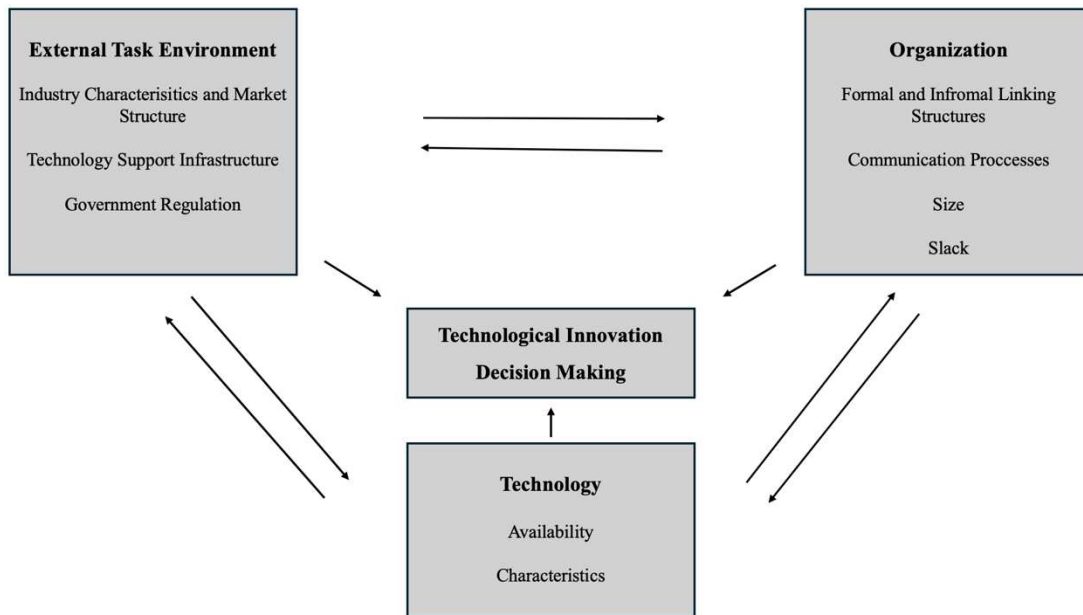


Figure 2: The TOE framework (Baker, 2012)

2.2.2 Critical Success Factors

When examining the adoption of AI in organizations, the TOE framework can serve as a central analytical lens through which critical success factors (CSFs) are identified and examined. This framework dissects the complex interplay between technological capabilities, organizational readiness, and overall environmental variables and provides a comprehensive understanding of the prerequisites for effective AI integration. In doing so, this section draws on the work of Alsheibani et al. (2019) and Enholm et al. (2022) who already looked at AI adoption at the firm level in a similar way. This chapter attempts to outline CSFs and provide a roadmap for companies looking to harness the transformative power of AI.

Technology

First, on a technological level, high-quality data, scalable infrastructure, and seamless system integration are essential for effective AI implementation in organizations.

Data

The essence of AI lies in its ability to learn from data rather than relying on predefined rules, therefore data is the foundation of AI performance (Bughin et al., 2017). The adoption of AI in organizations depends on the availability and quality of data, which must be well-structured and scalable (Brock & von Wangenheim, 2019; Brynjolfsson & McAfee, 2017; Demlehner et

al., 2021; Mikalef & Gupta, 2021; Ransbotham et al., 2017; Schmidt et al., 2020). Big data, which is characterized by its quantity, speed and variety, forms the basis for the development of high-quality AI applications (Beyer & Douglas, 2012; Mikalef et al., 2018).

However, AI systems require high-quality training data to deliver good results and there is a need for well-timed data updates, which is often a significant hurdle for companies (Baier et al., 2019; Davenport, 2018; Gregory et al., 2021). The quality of the data has a significant impact on the reliability of AI predictions. Problems such as incomplete data, incorrect inputs, and noisy features undermine the effectiveness of AI systems. Collaboration between data scientists and domain experts is crucial to identify and fix these quality issues (Alsheibani et al., 2018; Baier et al., 2019; J. Lee et al., 2019). In addition, reducing bias and adhering to principles for responsible data use is essential to ensure the ethical use of AI technologies (Geva et al., 2019; Ntoutsis et al., 2020).

Technology Infrastructure

Complementing data quality, and the right technology infrastructure is indispensable for AI adoption. Organizations must possess computing power, appropriate algorithms, and rich data sets to effectively deploy AI technologies (Alsheibani et al., 2020; Wamba-Taguimdje et al., 2020). Given the complexity of AI algorithms and the vast size of data sets, infrastructure capable of providing immense computing power and scalability is necessary. Cloud-based solutions from major companies like Google, Amazon, and Microsoft offer accessible infrastructure for ML, enabling organizations to adopt AI without the need for extensive on-site resources (Baier et al., 2019; Borges et al., 2021; Schmidt et al., 2020; Wang et al., 2019). Companies must either cultivate technical AI expertise internally or seek to acquire it externally (Brock & von Wangenheim, 2019).

Compatibility

In addition to data and infrastructure, the compatibility of all systems is of course also necessary. This also has an impact on IT capabilities and systems, which may further complicate AI adoption (Demary et al., 2016). According to Zhu, Kraemer, and Xu (2003), the adoption of digital innovations is influenced by an organization's technological competence, which is composed of IT infrastructure and IT know-how. This also includes the appropriate systems that provide the necessary computing power to process the data (Jöhnk et al., 2021). The technology must also be compatible with the intended tasks and there may need to be

adaptations to promote the introduction of AI (Alsheibani et al., 2018, 2020; Mishra & Pani, 2021; Pumplun et al., 2019).

Organization

Next, the section examines how organizational enablers and barriers affect the introduction of AI. These factors include cultural predisposition towards innovation, top management support, and organizational readiness.

Organizational Culture

Organizational culture emerges as a strong determinant in the decision to adopt AI technologies. Research suggests that a culture inclined towards innovation significantly facilitates the integration of AI into business models and systems (J. Lee et al., 2019; Mikalef & Gupta, 2021; Pumplun et al., 2019). Such a culture is characterized by a willingness to exploit new ideas and a passion for continuous learning and innovation. Organizations with an innovative culture are more likely to successfully integrate AI technologies, as they possess employees who are not only open to new technologies but are also capable of seizing new opportunities for AI applications (Mikalef & Gupta, 2021). Seitz (2016) even points out that changing the culture is even more difficult than the actual AI strategy. According to Brock and von Wangenheim (2019), the willingness to enter into partnerships and develop efficient ecosystems should also be created.

Top Management Support

Top management support is critical to the successful adoption of AI. This support goes beyond mere endorsement and includes active involvement in researching AI technologies, providing resources, and fostering a culture that is conducive to AI adoption (Alsheibani et al., 2018, 2020; Bughin et al., 2017; Demlehner & Laumer, 2020; Jöhnk et al., 2021). The role of top managers in creating a supportive culture and providing the necessary resources cannot be overestimated. Their commitment and dedication are important drivers for the use of AI in companies. Brock and von Wangenheim (2019) have also recognized the executive level as a CSF and found that insufficient support from leadership is a significant barrier. They advise that managers should take an active and leading role in supporting and guiding their organization's AI initiatives. Pumplun et al. (2019) add that it can be a challenge for SMEs if managers do not have the knowledge and understanding of AI.

Organizational Readiness

Organizational readiness encompasses the availability of necessary resources, both financial and human, for AI adoption. A dedicated budget and the absence of stringent performance targets can create an environment where employees feel empowered to explore AI solutions (Pumplun et al., 2019). Additionally, the technical and domain-specific expertise of the organization's workforce is pivotal. Employees must possess or acquire the necessary skills to develop and deploy AI systems effectively (Alsheibani et al., 2020; Mikalef & Gupta, 2021; Pumplun et al., 2019). Costs including indirect costs such as organizational restructuring, adaptation of processes or liabilities through AI-supported systems should also be covered by the budget as part of the AI investments (Jöhnk et al., 2021; Wannner et al., 2020). In addition to the necessary investment, the acceptance of changes by employees is a major challenge when implementing corporate technologies (Ghobakhloo et al., 2012). Kiron et al. (2019) make it clear that, particularly in the case of AI, this acceptance depends above all on employee understanding and the perceived value of AI-supported systems.

Environment

Concluding, the environmental CSFs affecting AI adoption by organizations are examined. Operating within dynamic and constantly changing landscapes, organizations face various external pressures and must navigate ethical, regulatory, and competitive environments to successfully adopt and implement AI technologies.

Ethical and Moral Considerations

The use of AI technologies raises profound ethical and moral questions, particularly due to their human-like characteristics and the potential to blur the boundaries between humans and machines. AI algorithms are designed to mimic human intelligence by learning from "real" data. However, this data often contains inherent biases - for example, about racism or sexism. By learning from such data, AI systems can unintentionally adopt and even reinforce these biases (Gründinger, 2019; Henke et al., 2016). It is therefore crucial that organizations ensure that the development of AI applications is based on ethical principles and free from biases that could promote discrimination (Alsheibani et al., 2020; Baier et al., 2019; Coombs et al., 2020). Ethical frameworks for AI, as proposed by the European Commission, define values, principles, and methods to promote moral behavior in the development and use of AI. They include aspects such as transparency, accountability, safety and the social good (European Commission, 2019a,

2019b). By adhering to these ethical guidelines, organizations can minimize risks and ensure that their AI deployments are ethically responsible (Barredo Arrieta et al., 2020).

Regulations and Legal Frameworks

Regulatory environments significantly influence the development and deployment of AI technologies. The General Data Protection Regulation (GDPR) in the EU, for example, has introduced complexities in handling personal data, impacting the use of data in AI training and necessitating anonymization (Baier et al., 2019; Pumplun et al., 2019). Such regulations can hinder AI adoption by increasing deployment complexity and raising concerns about intellectual property related to AI algorithms and datasets. Additionally, industry-specific regulations may pose extra challenges, particularly in highly regulated sectors like healthcare (Coombs et al., 2020; Demlehner & Laumer, 2020).

Competitive and Market Pressures

Competitive pressure plays a crucial role in motivating companies to introduce AI. Companies hope to gain or maintain a competitive advantage by adopting AI to reconfigure and adapt to rapid changes (AlSheibani et al., 2020; Demlehner & Laumer, 2020). This pressure can also arise from the market environment, as SMEs are often dependent on their business environment. Stakeholders along the value chain, such as suppliers and other stakeholders in the ecosystem, must also be considered when introducing AI and are an important part of a successful AI introduction (Alsheibani et al., 2018; De Búrca et al., 2005; Pumplun et al., 2019). In addition, customer expectations for personalized services and products continue to drive companies towards AI adoption. The demand for individualized solutions, as seen in the recommendation engines of platforms such as Netflix, illustrates this trend and underscores the importance of considering customer knowledge and acceptance during adoption (Pumplun et al., 2019).

2.3 Small and Medium-Sized Enterprises

This thesis refers to small and medium-sized enterprises (SMEs), as they are hidden champions and an important pillar of the modern economic system. Their very own characteristics are explained in this chapter to grasp the complexity of these companies. The range of topics covered by SMEs is complex and cannot be limited to one niche.

SMEs, with their distinct classification based on employee numbers and scale of operations, stand as pivotal elements within economies worldwide. Throughout history, SMEs have played

a crucial role in stimulating economic growth, generating employment, and maintaining social harmony across various regions. Their strategies and operations are tailored to navigate the intricate global and local market landscapes with remarkable agility (Immerschitt & Stumpf, 2019).

In 2003, the European Union (EU) defined SMEs as follows (Tab. 2):

Company Size	Employees	AND	Turnover	OR	Balance Sheet Total
Micro	< 10		≤ EUR 2m		≤ EUR 2m
Small	<50		≤ EUR 10m		≤ EUR 10m
Medium-sized	< 250		≤ EUR 50m		≤ EUR 43m

Table 2: SME definition of the EU Commission

The EU classifies companies as SMEs as businesses with no more than 249 employees and an annual turnover of no more than 50 million Euros or with a balance sheet total of less than 43 million Euros. Although a distinction can be made between the three categories (micro, small and medium-sized enterprises), they are all grouped under the common category of “SME”.

SMEs hold a pivotal role within the European Union, constituting 99% of all businesses and forming the very backbone of the European economy. As such, the European Commission has underscored the need to nurture entrepreneurship and bolster the business milieu for these enterprises (EC, 2022). SMEs contribute significantly to the gross domestic product (GDP), employment, and innovation across both developed and developing economies. Gherghina, Botezatu, Hosszu, and Simionescu (2020) provide empirical evidence on the positive impact of investments and innovation on SME growth, illustrating how these factors correlate with increased turnover and market expansion.

In addition to the quantitative definition, the use of qualitative characteristics and a combination of both is also useful for the definition of SMEs. This combination creates an even better basic understanding of SMEs (Arentz & Münstermann, 2013).

Features such as tradition or innovation no longer distinguish SMEs from large enterprises, as both can embody years of tradition and foster innovative ideas. Fundamentally, SMEs are often associated with ownership and management. This means that the owner makes and leads decisions, holding decision-making power and control over the company, while also bearing

responsibility for all employees and the risks of their decisions. To illustrate, a corporate manager at a conglomerate might risk their job with a poor decision, but for an SME owner, a bad decision could threaten the business's survival (Bruque & Moyano, 2007; Immerschitt & Stumpf, 2019).

The strategic framework of SMEs is predominantly characterized by inherent flexibility, an innovative spirit, and a focus on customer satisfaction. This agility empowers SMEs to swiftly adapt to shifts in market trends and consumer preferences, distinguishing them from their larger, less agile counterparts. The integration of information systems has been a game-changer for SMEs, enhancing their operational flexibility and strategic decision-making. Levy and Powell (1998) highlight how information systems have begun to significantly augment the operational efficiency of SMEs, enabling them to tap into new markets and manage resources more effectively. The technological investments underscore SMEs' journey towards embracing digital transformation to maintain their competitive edge.

Scholarship in this area has also identified characteristic features of SMEs that could be utilized in digital transformation. Quinton et al. (2018) have identified key characteristics of SMEs that are conducive to digital transformation, including entrepreneurship, innovation, learning orientation and a centralized power structure embodied by a single leader. Moeuf et al. (2020) have identified four leadership traits characteristic of SMEs, namely the propensity for short-term strategies, the central role of the SME manager, the low number of specialized support functions and a flatter organizational hierarchy. In addition, Laforet and Tann (2006) have identified four critical characteristics - culture, processes, leadership, and corporate strategy - which they assume strongly influence innovation in SMEs. Prasanna et al. (2019) discuss the technological challenges faced by SMEs. They identified six driving forces that influence technological progress in SMEs: social capital, links with multinational and transnational companies, innovation, exchange and networking, information technology, and the introduction of productivity-enhancing technologies. Additionally, they highlighted two conditions for successful technological adaptation in the SME sector: the availability of a technologically skilled workforce in the economy and the identification of competitive opportunities for new technologies.

However, SMEs face several challenges, including stiff competition from both local and international markets, access to finance, and scaling operations efficiently. The global

competitive landscape, marked by rapid technological advancements and globalization, presents various opportunities and challenges. SMEs are required to leverage their strengths, such as flexibility and innovation while adopting new technologies and engaging in strategic marketing and internationalization to stay competitive. Knight (2000) underscores the critical roles of entrepreneurial orientation and marketing strategies for SMEs in the context of globalization, emphasizing the need for SME managers to adapt to these evolving dynamics.

2.3.1 German SMEs

The German economy employs its metrics for classifying companies as SMEs and adapts the metrics from the European System. The Institute for SME Research (IfM) provides a definition specific to Germany, where businesses with up to 499 employees and an annual turnover which doesn't exceed more than 50 million Euros are considered SMEs (Tab. 3).

Company Size	Employees	AND	Turnover
Micro	< 10		≤ EUR 2m
Small	< 50		≤ EUR 10m
Medium-sized	< 500		≤ EUR 50m

Table 3: SME definition of the Federal Republic of Germany

SMEs play a significantly important role in Germany as in the rest of Europe. From a statistical perspective, SMEs in Germany account for more than 99.3% of German enterprises, which is in line with the macro-European environment. Terms such as economic engine, regional, crisis-resistant, responsible, innovative, and owner-operated are associated with German SMEs. Almost 50%, exactly 1,307 of the world's 2,700 Hidden Champions are German SMEs, underscoring their importance to the global standing of German SMEs. In Germany, when SMEs, also known as “Mittelstand,” are mentioned, they are often equated with family businesses, as 94% of them are family-owned. Recognizing the importance of strategic foresight in workforce development, it is imperative to invest in the cultivation of new talent from an early stage. This perspective is exemplified by the fact that approximately 70% of apprentices in Germany are trained by SMEs, showcasing their commitment to shaping a skilled future workforce through deliberate and thoughtful planning. These statistics provide an initial insight into the importance of SMEs in the overall economy (BVMV, n.d.).

2.3.2 Challenges and Opportunities for German SMEs

Today, German SMEs are facing challenges such as digital transformation and demographic change (Dengler, 2018; Leeftang, 2014; Papen, 2022). Their ability to adapt and foster innovation remains crucial to the future viability of the German economy. Despite these challenges, SMEs maintain their role as the backbone of the economy, supported by a long tradition of quality, specialization, and innovation that makes them an indispensable part of the German economic model. These aspects are particularly important against the backdrop of increasing global competition and the need for sustainable corporate management. According to the Federal Ministry for Economic Affairs and Energy (BMWi, 2016), digital transformation is not only a challenge for SMEs but also an opportunity to strengthen their competitive position and tap into new markets. In addition, the Institute for SME Research (IfM Bonn) emphasizes that demographic developments require the targeted promotion of skilled workers and the adaptation of working models to maintain the innovative strength and agility of SMEs. German SMEs therefore play a central role in overcoming current and future economic challenges by combining their traditional strengths with new technologies and working methods.

The digital transformation of German SMEs brings with it many challenges that also have a direct impact on their global competitiveness. Lack of digital know-how and skilled labor as well as concerns about data protection and cyber security are among the main problems (PwC, 2018; World Economic Forum, 2023). These factors make it difficult for SMEs to fully implement digital technologies and processes and reap the benefits of digitalization. Despite these challenges, progress is being made: Many SMEs are increasingly recognizing the importance of digital transformation and are taking steps to digitize their business models, processes, and products. However, the status also shows that there are significant differences in the implementation and integration of digital technologies, with some SMEs leading the way in digitalization while others are still in the early stages (Papen, 2022). The German government and various industry associations offer support and funding programs to help SMEs with digital transformation and bridge the digital divide. According to a study by the Federal Ministry for Economic Affairs and Energy, the willingness to digitize among German SMEs has increased, but there are clear differences in the implementation and progress of the digital transformation depending on the industry and size (Stich et al., 2022). This divergence underlines the need for targeted support and advice to enable all SMEs to benefit from digitalization and secure their long-term competitiveness.

German SMEs need to get to grips with technological progress, invest in their employees' qualifications, and enter strategic partnerships to maximize their potential. Government funding and industry initiatives, such as the Federal Ministry for Economic Affairs and Climate Protection's "Digital Jetzt" program, can help with the introduction of AI and increase innovation and competitiveness in the long term (BMWK, n.d.). As part of this initiative, a platform has been established to assist SMEs in executing their digitalization projects. This platform offers SMEs complimentary support for their digitalization endeavors and provides access to a repository of best practices implemented by other SMEs in partnership with the platform and its collaborators. An exemplary project is detailed in Appendix A as a best practice case.

Given their reduced size, these organizations are generally more flexible, enabling them to quickly adapt to emerging opportunities or threats in their environment (Eggers, 2020). Furthermore, the decision-makers tend to be to their customers and other critical stakeholders the smaller the organization (Eggers et al., 2012). This provides a good basis for acting quickly.

In particular, the required investment in technology and expertise as well as concerns about data protection and ethical issues are major challenges when introducing AI (Lindner, 2023). Despite these challenges, AI offers SMEs the opportunity to strengthen their competitiveness by optimizing processes, driving innovation, and creating personalized customer experiences. Traditionally, SMEs are characterized by dynamism and adaptability. This could help them to quickly exploit the potential of AI and position themselves successfully in an increasingly digitalized economy.

Ulrich, Frank and Kratt (2020) conducted an empirical study with 283 German SMEs to investigate the use of AI in German SMEs. The study revealed the following findings about the opportunities of AI in SMEs. 77% of respondents see the greatest potential of AI for SMEs in process automation, while 72% see the benefits in the efficient use of data. In addition, 66% cite faster processes as an advantage and 55% see cost savings through AI as beneficial. In addition, 53% see the streamlining of processes as an advantage, and the same percentage point to improved decision-making options. However, less than half recognize the role of AI in developing new business models (43%), improving risk management (31%), and improving working capital management (19%). In the assessment of barriers, 65% of respondents cited a lack of expertise as the main obstacle. Implementation challenges were cited by 52% of

respondents, with an equal percentage citing data issues as the main barrier to the use of AI in SMEs. In addition, 46% of respondents cited IT infrastructure deficiencies as a barrier, while 39% cited financial constraints. Other barriers include a lack of management commitment and regulatory challenges, each cited by 32% of respondents. The lack of a clear business case is seen as a problem by 28% of respondents, while 13% fear the threat of cyber security. Finally, 7% see no added value from AI and a further 7% express the fear that AI could displace human tasks.

In a survey by Schaller et al. (2023), only 13.3% of around 6,600 companies surveyed in Germany stated that they already use AI and only 9.2% are currently planning to implement AI.

3.0 Methodology

This third chapter describes the methodology for this thesis.

3.1 Research Design

This thesis aims to identify CSF for the adoption of AI for SMEs in Germany.

To investigate the research question, the study relies on an analysis of existing literature, including academic articles and consultancy reports, as well as conducting semi-structured interviews. This type of interview was chosen because the predetermined guide provides a fixed structure, but a degree of flexibility that allows for spontaneous responses to themes (Misoch, 2019). This flexibility is important for the study of CSFs in German SMEs as the topic is highly topical and evolving daily and people from different industries may have different approaches and challenges. A qualitative approach was chosen to better understand the individual experiences, perceptions, behaviors, and their meaning (Agius, 2013). Fundamentally, the main aim of empirical research is to gain reliable insights into reality (Kromrey, 2002). To this end, research can be qualitative or quantitative. (Allwood, 2012). While quantitative research takes an objective approach, qualitative research, which was also conducted here, can gain a deep insight into the complex situation thanks to inductive analysis (Yauch & Steudel, 2003).

3.2 Data Collection

Using semi-structured interviews, researchers strive for comprehensive insights by asking open-ended questions. This method provides respondents with ample room for in-depth answers and self-expression, as highlighted in Galetta's 2013 study. Furthermore, interviewers

customize their question guides to elicit detailed responses from subject matter experts, a strategy discussed by Qu and Dumay in 2011. For this study, 16 people were interviewed. On the one hand, four managing directors were interviewed for each definition level of SMEs, micro, small and medium, as well as four consultants who were already advising and supporting SMEs in the adoption of AI (Tab. 4). These participants were either from the private network or were identified and approached via company websites or LinkedIn. There are separate questionnaires for the managing directors and the consultants, which are slightly adapted in terms of wording. Due to the sensitive nature of the interview content, all participants were guaranteed anonymity. The interviews were conducted in English or German. Depending on the participant's preference and knowledge about AI, lasted between 30 and 60 minutes. The interviewees had to already have initial experience with the adaptation of AI in their company or a SME. These experts are from different types of companies and different industries to provide a rich variety of perspectives on the research question.

Role	Classification	#	Industry	Knowledge of AI
Managing Director	Micro	A	Engineering services	~ 1 year
		B	Marketing agency	~ 3 years
		C	Real estate management	~ 2 years
		D	Special tool manufacturer	~ 1 years
	Small	E	Beverage manufacturers	~ 2 years
		F	Logistics	~ 2 years
		G	Software	~ 4 years
		H	Swimming pool technology	~ 1 year
	Medium	I	Architectural solutions	~ 3 years
		J	eCommerce	~ 3 years
		K	Media & Communications	~ 3 years
		L	Steel trade	~ 2 years
Consultant	M	Life sciences	~ 2 years	
	N	Operations	~ 2 years	
	O	Procurement	~ 2 years	
	P	Strategy	~ 4 years	

Table 4: List of experts interviewed

The 16 interviews were conducted for around three weeks, from April 8 to 26. All interviews were conducted via Microsoft Teams due to the different locations. Two weeks beforehand, test interviews were conducted with a managing director and one with a consultant to test the questionnaire and adapt it based on their feedback. These two test interviews were not included in the final evaluation but are important to assess the effectiveness of the interviews (Magnusson & Marecek, 2015).

An interview always begins with the introduction of both parties and the presentation of the research objective. The questionnaire was structured to first briefly address the person and the company, the transition to AI in the context of SMEs or the consultants' projects of AI in SMEs. Once the environment and context were known, the questionnaire aimed to explore the technological, organizational, and environmental aspects of CSFs. This was done in an open-ended interview, so the questions themselves were not always applied but guided the interview. The final guidelines for the questionnaires can be found in Appendices B and C.

During the actual interviews, the audio material was recorded, in consultation with the interviewee. Over 10 hours of audio material was collected, which was transcribed directly using the transcription tool "Transcriptor".

3.3 Evaluation of the Interviews

Before the actual analysis began, all interviews were downloaded as Word files and the German interviews were translated into English, taking care to ensure that the choice of words was clear and meaningful. This is the only way to ensure a factually correct analysis.

To answer the research question and ensure a structured analysis, the qualitative analysis is based on Kuckartz's analysis process (2019). This method makes it possible to use an inductive approach and validate some of the theoretical concepts and to use a deductive approach to explore new avenues that emerge from the interviews. Thus, adding value to the academic knowledge. It is a recognized method in qualitative research and offers a systematic and transparent application. The category system makes it possible to access and evaluate the data step by step. The framework for the analysis is already laid out in the literature and is aligned with chapter 2.2.2 CSF along the TOE framework. The following Table 5 shows the categories and their description.

Category	#	Description
1. Description of AI	AI	Statements that describe or define AI, both from a technical perspective and from a corporate or pragmatic point of view.
2. AI in the context of SMEs and Digital Transformation	DT	All statements that generally place AI in the context of SMEs and/or digital transformation.
3. Use cases of AI	UC	Compilation of statements on (potential) use cases of AI.
4. Technology	T	Level of TOE Framework, the following CSFs as subcategories: Data, Infrastructure, Compatibility.
5. Organization	O	Level of TOE Framework, the following CSFs as subcategories: Culture, Top Management Support, Readiness.
6. Environment	E	Level of TOE Framework, the following CSFs as subcategories: Ethical and Moral, Regulations and Legal Frameworks, Competition and Market Pressure.
7. Others	X	Other statements that are also considered interesting.

Table 5: Categories of statements

The interviews were then analyzed, and the statements were assigned to the above specially created categories. The following pattern was used for the interpretation of statements that could be assigned to a sub-category of the TOE framework.

- A “+” was awarded if a CSF was identified, but this does not represent an obstacle, as the company is well positioned in this respect according to this statement.
- A “-” was assigned if a CSF was identified that represents an obstacle, as the company has problems overcoming this obstacle according to this statement.

The final evaluation with all citations is in Appendix D.

4.0 Results

This fourth chapter presents the results of the interview analysis.

As described in Chapter 3, the statements were classified into specially created categories. Below are sample excerpts with three expressive statements per category. The complete summary of the interviews can be found in the Appendix D. Table 6 shows how the interviewees describe AI.

Description of AI		
#	Interviewee ID	
AI2	K	It's like a crane on a building site. The crane doesn't know where to put what either. So somehow the human has to do it. But of course it exponentially increases the load that I can transport, the speed at which I can set something up.
AI4	N	Artificial intelligence is the study of intelligent problem-solving behavior and the development of intelligent computer systems and deals with methods that enable a computer to solve tasks that, when solved by humans, require intelligence.
AI6	P	I would define AI as a computer or computer performance that acts like a human and can reproduce or produce behavior and working methods independently.

Table 6: Excerpt from interview statements - 1

Next Table 7 shows statements that place AI in the context of SMEs and/or digital transformation.

AI in Context of SMEs & Digital Transformation		
#	Interviewee ID	
DT3	E	Let's put it this way, the broad SME sector won't jump on the bandwagon immediately and will first see what the big companies are doing.
DT7	I	As a German medium-sized company, we want to use AI to be more than just a hidden champion, which brings a lot of opportunities for us in the digital transformation.
DT9	L	For many German SMEs, AI is both a huge opportunity and a threat. In the context of digital transformation and all the problems we have, there are opportunities to grow even further.

Table 7: Excerpt from interview statements - 2

Next is the category of AI use cases, Table 8 shows an excerpt of the statements from the interviews.

Use Cases of AI		
#	Interviewee ID	
UC4	D	We don't have any use cases at the moment, but I think there will be some exciting things for us in the future. I think there will soon be AI-based software for us that can help us optimize the tools, for example in the use of materials to make the tool as functional but as light as possible.
UC14	J	Formulation of emails, translations, as an optimized search engine, processing and analysis of data, data maintenance, that's how it started with AI in our company.
UC15	J	So there are so many business cases, for example a very simple customer service contact, if I want an invoice from the company, if I want to register a return. This and more can be done by an AI Chatbot.

Table 8: Excerpt from interview statements - 3

After the first general categories that allow a better understanding of the environment, the CSF is analyzed at the level of the TOE framework to build on the literature and dive deeper into the research. Chapter 3.3 Analysis of the interviews has already explained how the analysis works.

According to the statements, at the technology level data is a barrier for most companies. However, the other two points, infrastructure, and compatibility, were viewed positively by most companies. Figure 3 summarizes the results of the statements on the technology level.

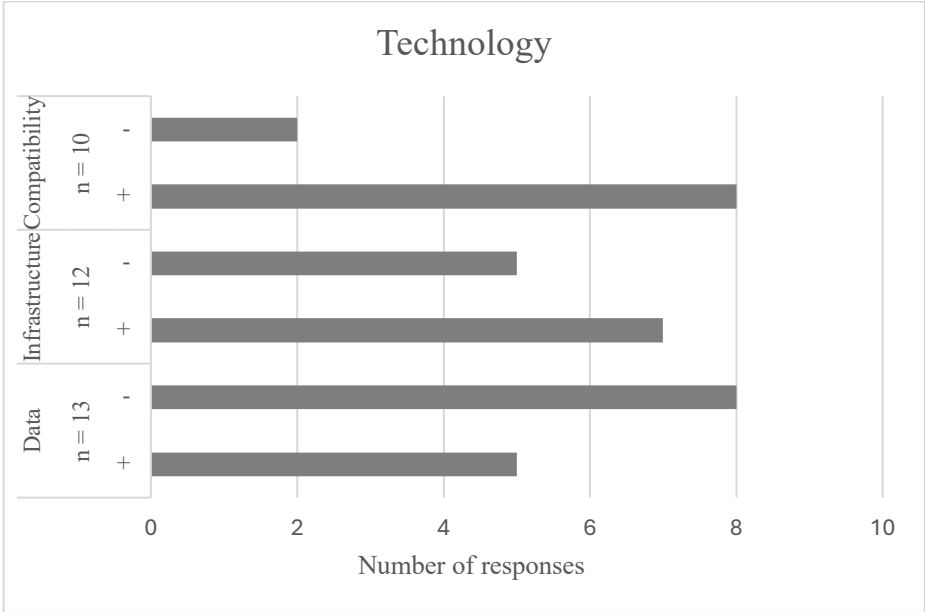


Figure 3: Classification and evaluation of the interview statements - Technology

Next, Figure 4 summarizes the organizational level results. It clearly shows that for most companies, culture is a barrier to AI implementation. Opinions differ on whether management support is still a barrier. Regarding readiness, most companies are critical, with only four positive statements and six considering it a barrier.

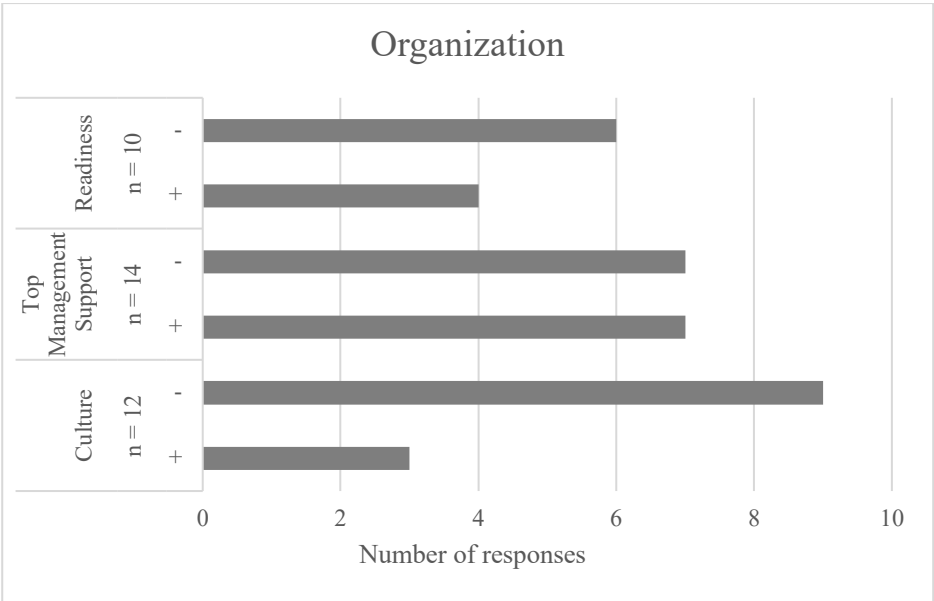


Figure 4: Classification and evaluation of the interview statements - Organization

At the last level, the environment level, statements that see CSFs as a challenge for AI implementation that is still too outdated predominate. This is most clearly the case with ethical and moral concerns. Companies are somewhat more favorably disposed towards regulatory and legal issues. Competition and Market Pressure are almost balanced, as many companies also see this as an opportunity. The summary shows the following in Figure 5.

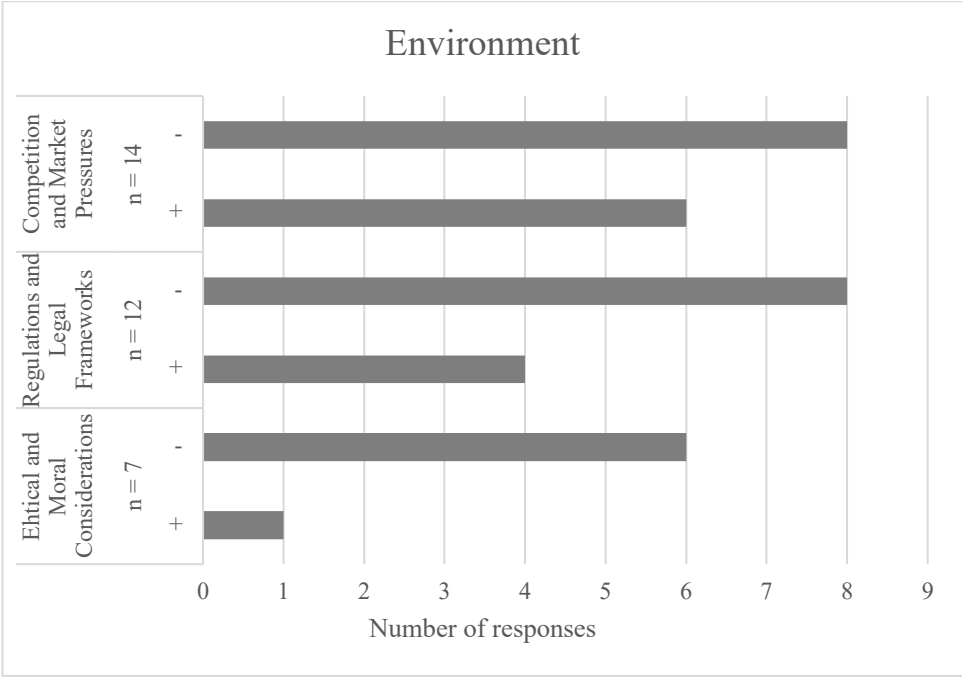


Figure 5: Classification and evaluation of the interview statements - Environment

5.0 Discussion

In this chapter, the qualitative research is presented and linked to the research from the literature. At the beginning is a general discussion of AI in German SMEs. This is followed by an analysis of CSFs at the TOE level. Lastly, theoretical, and practical implications are considered. All interview statements can be found in Appendix D.

5.1 General Discussion

When analyzing the interviews, it becomes clear how versatile AI is and how it can be used. Whether as a personal companion in everyday life or industry-specific everyday cases, where AI-supported solutions are the future. AI does not yet have a general definition in everyday life; the topic and its use in a wide variety of areas is currently being explored.

The literature provides various definitions of AI on a factual level, but interviewee *K* was more pragmatic. He describes AI "as a huge opportunity" (statement: AI1). This has already been recognized in the literature (Brynjolfsson & McAfee, 2017; Chui et al., 2023b; Maslej et al., 2024). Interviewee *K* continues, "It's like a crane on a building site. The crane doesn't know where to put what either. So somehow humans must do it. But of course, it exponentially increases the load that I can transport, the speed at which I can set something up." (AI2). In addition, *O* says that AI is like a co-pilot (AI5). Similar to this statement, AI has already been described in the literature by Dwivedi et al. (2021) and Schmidt et al. (2020), among others. Interviewee *P* is somewhat more factual and describes AI as follows: "I would define AI as a computer or computer performance that acts like a human and can reproduce or produce behavior and working methods independently." (AI6). The statements on this are unanimous, as is the literature: AI is an enabler for our daily lives. Whether on a personal or corporate level, AI can be used to make everyday life and processes more effective, which can lead to more and/or better work, for example. However, the literature is more concerned with what (human) AI can already do or will be able to do in the future, which gives the impression that it could replace a human being (Brynjolfsson & McAfee, 2017; Lichtenthaler, 2019; Mikalef & Gupta, 2021). From the interviews, however, AI is a supplement for a human who uses it correctly.

The interviewees also placed the topic of AI in the context of digital transformation, similar to the literature (Brock & von Wangenheim, 2019; Warner & Wäger, 2019). Both the literature and the qualitative research emphasized the topic in the context of the necessary digital transformation for German SMEs. A total of seven interviewees (interviewees: *A*; *D*; *H*; *I*; *L*; *N*; *P*) put AI in the context of digital transformation and describe, for example, "AI is a tool within the digital transformation" (DT2). Interviewee *I* says that AI has "[...]a lot of opportunities for us in the digital transformation." (DT7). Interviewee *K* points out that we are in a permanent digital transformation, especially now with AI (DT8). "For many German SMEs, AI is both a huge opportunity and a threat. In the context of digital transformation and all the problems we have, there are opportunities to grow even further." (DT9), says interviewee *L*. Consultant *O* appropriately says that "It is foreseeable that companies that successfully invest in AI will have a greater competitive advantage in the long term than those that do not." (DT11).

Regarding the use of AI, there were all kinds of answers. But it's also like Interviewee *E* says: "I suspect that many things would probably already be possible now, but that people don't really dare to do them yet." (UC6). And so many people don't know where AI can already be used, or

even what future use cases are. The use of LLMs such as ChatGPT is already widespread. Various interviewees stated that they use it, for example, to generate marketing content, write texts, translate, structure data and ideas or as a search engine (UC2; UC5; UC11; UC14; UC16; UC18; UC25). This aligns with Chui et al.'s (2022) ideas on the use of GenAI in various areas, shown in Table 1 in Chapter 2.1.1. Interviewees *C* and *I* stated that they use the functions in everyday Microsoft applications, such as Microsoft Co-pilot (UC3; UC13). Interviewee *L* said, "Within Europe, we have built the first steel machine that works based on AI. This machine is still the market leader." (UC20). There were also other (industry) specific examples such as the creation of training videos (UC9) or the use of AI-supported negotiation robots in purchasing (UC23). All interviewees see a use case. "So far, it's been a lot of trying things out and seeing what's available." (UC16) says *K*. As a result, more AI will gradually become established in the German Mittelstand.

The topic of AI in German SMEs is a current trend and highly disruptive, leading to a lack of uniform understanding and implementation of AI in the German SME sector. While AI has been extensively researched in both literature and practice, the real-world economy still lacks a cohesive understanding of AI. This disparity hinders the effective implementation of AI technologies in German SMEs. The literature indicates that German SMEs are struggling with digital transformation (BMW, 2020; IfM Bonn, 2023). In addition, various AI applications are gradually offering solutions to these problems. For example, increasing the efficiency of processes or new machine capabilities can mitigate the problems of demographic change. SMEs, with their flat hierarchies and quick decision-making structures, are well-suited to adopt disruptive innovations driven by AI (Reinemann, 2019).

However, one major challenge remains. A decision is always associated with a major risk, and German SMEs are traditionally not very risk-averse. A single wrong decision can destroy the future of the company, leading to a reluctance to take risks (Immerschitt & Stumpf, 2019). SMEs are therefore cautious when it comes to investing in the field of AI, as this is seen as risky despite all the opportunities that AI offers and the competitive pressure. Interviews with a cross-section of German SMEs also show that although they are looking into AI, they are hesitant to make major investments. Financially, these companies are often well positioned, which underlines the need for a deeper analysis of the obstacles to the introduction of AI.

5.2 CSF in German SMEs

Based on the literature, several CSFs hinder AI adaption and are underpinned by interview statements. Following, a conceptual model incorporating these CSFs within the TOE framework can be derived (Figure 6).

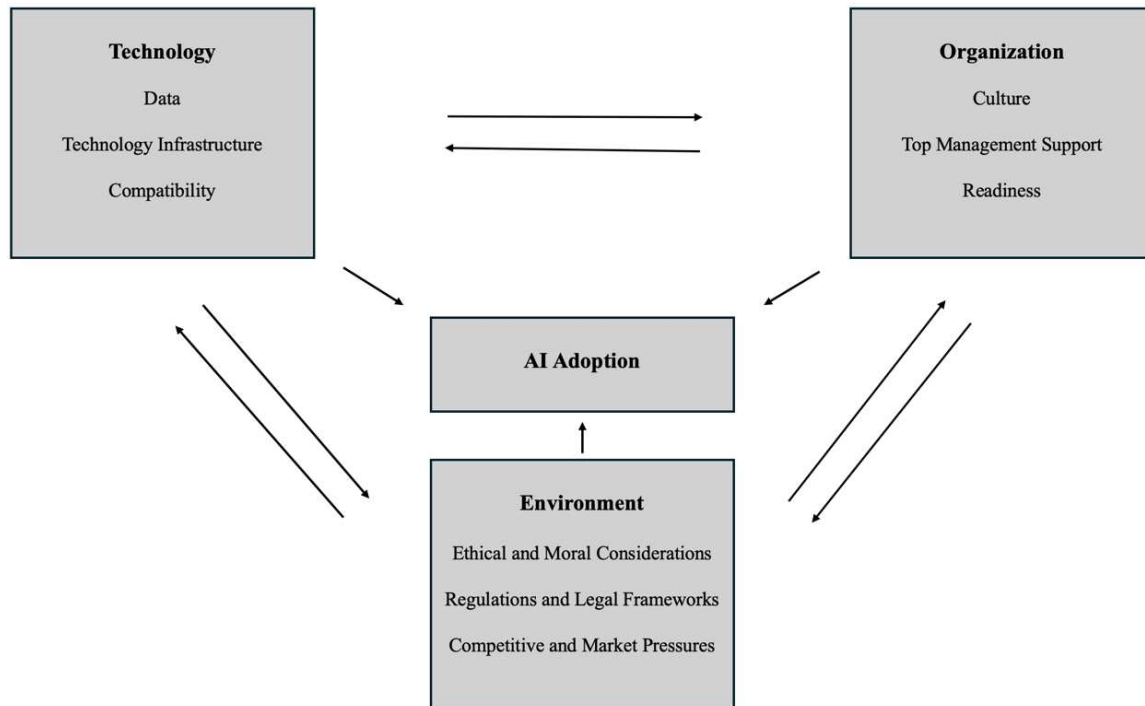


Figure 6: Conceptual model – CSF in TOE framework

The statements from the interviews were sorted on the three levels of the TOE framework in the same way as they had already been pre-sorted by the CSF in the literature. In this way, it is possible to examine how the interviewees perceive the CSFs and what attitude they have towards them.

Technology

At the technological level, CSFs such as data, infrastructure, and compatibility have emerged, as highlighted in the literature. While most SMEs still view data as a significant obstacle, many consider themselves well-positioned in terms of AI compatibility. Respondents from various categories reported challenges in data collection or a lack of understanding about how and where to obtain the necessary data, often because it was not in the right format (interviewees: *A; B; C; E; L; M; O; P*). This issue of collecting, storing, and processing data is frequently discussed in the literature (Baier et al., 2019; Davenport, 2018; Gregory et al., 2020). The micro-sized companies, which are service providers, do not collect their data and so interviewee *B*

says, “We don't collect any data” (T2). In contrast, larger company *K*, for example, says “We have countless pieces of data, both collected internally and from customers” (T14). Only five respondents indicated that they already had the necessary data for AI applications and identified themselves as more digital companies (interviewees: *D*; *F*; *I*; *K*; *N*).

All companies that already have their data available digitally also stated that they have the necessary infrastructure, which in turn indicates that they are a digital company, which was confirmed by the consultants (interviewees: *N*, *P*). The infrastructure referred to includes robust cloud-based solutions, high-performance computing systems, and advanced data storage facilities. For instance, cloud platforms like Microsoft Azure, Amazon Web Services (AWS), and Google Cloud offer scalable computing power essential for AI workloads, including advanced virtual machines, extensive data storage, and seamless integration across various environments (Ayuya, 2024).

The fewest comments were made regarding compatibility, which also received the least concern about AI implementation. Eight respondents indicated they were well-positioned in this area (interviewees: *C*; *D*; *G*; *I*; *J*; *K*; *N*; *P*), while only two companies reported ongoing issues (interviewees: *L*; *M*). Thus, while infrastructure and compatibility are relatively strong, German SMEs struggle significantly with data management. Years of analogue operations have left data in unusable formats, as illustrated by Interviewee *L*'s comment: "What we need to do first is collect data on which we can build. There is still far too much analogue in our company." (T16).

On the technological side, actions should occur almost simultaneously, as each often depends on the other. The creation, collection, and evaluation of data are only feasible if the necessary infrastructure and compatibility are established (Brynjolfsson & McAfee, 2017; Mikalef & Gupta, 2021; Ransbotham et al., 2018). German SMEs should collect and store their data digitally to evaluate it later and integrate AI-supported systems. This process requires careful consideration of what data is available and how it can be stored and utilized. Ensuring system compatibility and robust infrastructure is essential. Therefore, companies need to develop and implement a comprehensive digital strategy.

Organization

When examining culture, top management support, and organizational readiness at the organizational level, distinct trends emerge. Only three respondents (interviewees: *A*; *B*; *C*) state

that the culture is positive for the adoption of AI, e.g. *K* says that there has been a cultural shift in recent years (O24). However, most respondents (interviewees: *D; G; H; J; L; N; O; P*) identify culture as the primary obstacle. Interviewee *H* highlights this by stating, “In our company, we have a culture that is rather closed to new things and prefers to stick to the old.” This describes the closed attitude towards new things in general. Interviewee *J* adds: “The cultural issue is probably the most critical for us. So far, it's still more of an IT and nerd topic” and *F* adds that the culture sees it as a threat rather than an opportunity, pointing out that employees are afraid of being replaced by AI. That culture is the biggest problem is supported by research from the literature (Lee et al., 2019; Mikalef & Gupta, 2021; Pumplun et al., 2019).

In terms of top management support, responses are evenly split. On the one hand, seven managers say that they want to lead and guide the company towards more AI (interviewees: *A; B; E; F; G; I; K*), while on the other hand, seven different managers are rather reluctant (interviewees: *C; D; J; L; M; O; P*).

In terms of organizational readiness for AI, only four respondents (interviewees: *E; G; I; K*) report favorable conditions. Interestingly, *G* says it can develop the AI itself at any time thanks to its strong development team. The other statements (interviewees: *H; J; L; M; N; P*) see readiness more critically and as a greater hurdle. Consultants *M, N* and *P* seem to agree that readiness still needs to be improved, including through the provision of resources.

At this level, it is very important in German SMEs that the company management leads the way. It has a major influence on corporate culture (Alsheiabni et al, 2018; AlSheibani et al, 2020; Demlehner & Laumer, 2020). The company management should deal intensively with the topic. This can be achieved either by acquiring expertise themselves or by bringing in new employees or consultancy services with the necessary knowledge. When top management advocates for AI, it can and should foster a supportive culture within the company. Interviewee *L* also states that it was his mistake not to communicate the topic properly within the company (O28). Other companies are now pioneers of sorts in this area and are making efforts to train and educate employees (interviewees *H; J; K*). This approach raises awareness of AI and can positively influence employee attitudes and readiness for rapid AI implementation. The readiness of the entire company can be created in the same way. Human capital is increased, e.g. through investment in training or new employees, and lays the foundation for future investment in the technical and human areas necessary for an AI-enabled business. The

literature also emphasizes that human capital and the associated knowledge or training are essential for AI readiness (Alsheibani et al., 2020; Mikalef & Gupta, 2021; Pumplun et al., 2019).

Environment

At the environmental level, ethical and moral considerations were mentioned the least. Most did not comment on this, but interviewee *I* stated that the introduction of AI did not raise any moral issues for her (E15). Conversely, six respondents (interviewees: *B; C; D; E; F; M*) acknowledged ethical and moral challenges. It is important to ensure AI benefits comply with the European Commission's requirements and are morally justifiable (European Commission, 2019a; European Commission, 2019b).

Regarding regulatory and legal barriers, most respondents identified these as obstacles to AI adoption in SMEs (interviewees: *A; C; E; F; L; M; N; O*). There were statements on the statutory and legal levels at the federal level as well as at the company level. A further four statements have their own rules or deliberately no rules for AI in the company (interviewees: *I; J; K; P*). Literature often focuses on governmental and industry regulations rather than internal policies, which also require clarification (Pumplun et al., 2019; Demlehner & Laumer, 2020).

Lastly, competition and market environment were seen as critical hurdles by many respondents (interviewees: *D; E; F; J; L; M; N; O*), particularly regarding competitors and competitive pressure. However, six respondents did not view this as an obstacle (interviewees: *A; B; G; H; I; P*). Of particular interest here is *P*'s idea, which also addresses the exchange of data between competitors and points out that this could result in even greater efficiency gains for all parties involved (E30).

The deeper the topic is dealt with in the company, the more ethical, moral, regulatory, and legal issues will arise. Many companies are not yet aware of what AI will mean for them in this sense. While only six respondents expressed ethical and moral concerns, the literature addresses these issues in much greater detail (Alsheibani et al., 2020; Baier et al., 2019; Coombs et al., 2020). German SMEs must be prepared for the issues that arise in this context and create an ethical and legal framework. Furthermore, the legal framework can always be influenced by other stakeholders, such as politicians, suppliers, and other business partners (Alsheibani et al. 2018; Pumplun et al., 2019). This leads directly to the last point, competition, and market pressure.

This can also drive or inhibit the implementation of AI in various functions. Companies should use AI as a tool to minimize the pressure from this side and even gain a competitive advantage through AI (AlSheibani et al., 2020; Demlehner & Laumer, 2020). First and foremost, companies should keep their benefits in mind and discuss them with other stakeholders, if necessary, as this may create even more efficiency.

To sum up, a German SME, that not only deals with the respective CSFs at the three levels but also addresses them all, creates the future for a digital, successful future, with AI.

5.3 Implications

Theoretical implications

First, this thesis extends the TOE framework by highlighting specific aspects of AI integration in SMEs. The research highlights the importance of data quality and technological know-how as key technological success factors, suggesting that future research should examine these elements in more detail to develop a more comprehensive understanding of technology adoption.

Moreover, the findings highlight the need for an interdisciplinary research approach that integrates technological, organizational, and environmental perspectives. This approach makes it possible to better grasp the multi-layered dynamics of AI adoption and to develop theoretical models that consider the complex interactions between different influencing factors.

Additionally, the work contributes to the theoretical debate on the ethical and regulatory challenges associated with AI use. It emphasizes the need for clear guidelines and principles for the responsible use of AI technologies. These findings are particularly relevant for the development of political and legal frameworks that ensure that AI is used ethically and socially responsibly.

Practical implications

On a practical level, the results offer valuable advice for the successful implementation of AI in SMEs. A key practical aspect is the development of effective data management strategies. SMEs should invest specifically in improving data quality and availability to lay the foundation for successful AI applications. This could be achieved using advanced data infrastructure and management systems.

This thesis also underscores the promotion of training and development programs for employees is crucial. These programs should aim to develop the necessary technological knowledge and understanding of AI technologies within the organization. By upskilling the workforce, SMEs can ensure that their employees have the skills to effectively use and implement AI solutions.

Furthermore, strong support and active involvement from top management is essential. Leaders should foster a culture of innovation and create organizational readiness for AI adoption. This includes not only providing the necessary resources but also active participation in the planning and implementation of AI projects. Clear leadership and support can break down barriers and increase the acceptance of new technologies within the organization.

6.0 Conclusion

The concluding remarks on this thesis are followed by its limitations and a call for further research.

This thesis aimed to identify and analyze CSFs at the levels of the TOE framework for the introduction of AI in German SMEs. The findings of this thesis are based on a comprehensive literature review and semi-structured interviews with 16 experts from different industries. The results show that German SMEs vary greatly in their ability to successfully integrate AI.

At the technological level, the research revealed that high-quality and accessible data is fundamental to effective AI implementation. Many SMEs struggle to manage and use their data effectively. A robust technological infrastructure that can support AI applications is also crucial. This includes sufficient computing power and scalable systems. It is also essential that new AI systems are seamlessly integrated with existing technologies to ensure successful adoption.

At an organizational level, a culture that is open to innovation and the use of AI is paramount. The attitude and commitment of senior management is critical to shaping this culture and the adoption of AI. In addition, financial and human resources allocated to AI initiatives have a significant impact on success. This underscores the need to invest in training and education to build AI competencies.

At the third level, the environmental level, compliance with data protection and ethics regulations is essential. SMEs must comply with these regulations to avoid legal pitfalls. Competitive dynamics are driving SMEs to introduce AI to gain or maintain a competitive advantage. Market demand for personalized and efficient services puts additional pressure on SMEs to integrate AI. Responsible AI deployment that addresses biases and ensures transparency is necessary to maintain trust and uphold ethical standards.

This thesis provides a basis for understanding the critical success factors for AI adoption in German SMEs. The introduction of AI offers companies significant opportunities, such as combating the shortage of skilled workers or increasing productivity and competitiveness. By considering the identified CSFs, SMEs can better navigate the complexity of AI adoption and harness the potential of AI to drive digital transformation and business success.

6.1 Limitations

The results of this thesis are subject to various constraints such as the selection of papers for the literature review, the selection of participants, and the limitation of the thesis.

The Literature Review is based on a selection of journals and articles. Different researchers may identify different or additional literature. This point arguably applies to any systematic literature review (Greenhalgh et al., 2004).

The selection of interview partners was also limited by the scope of the work and the availability of selected target persons. In accordance with my specifications, I randomly selected managing directors from German SMEs who told me about the situation in the company concerning AI adaptation. In addition, four consultants were selected who also reported on their experiences with AI projects in SME projects. The selection was made without any further procedure. On the one hand, I was limited to the statements of these people when evaluating the interviews; on the other hand, other people, whether from the same or a different company, could have made other statements that would have led to a different result.

In addition, this thesis is limited to a certain number of characters, which does not allow me to go into detail and analyze more. Finally, it should be added that the topic of AI is currently developing rapidly, and this thesis is therefore only a snapshot. It should be noted that the technology is developing and spreading rapidly.

6.2 Further Research

This thesis provides an initial review of how the literature converges with in-depth qualitative research on the CSF of AI adoption in German SMEs. Future research can consider this thesis despite its limitations, so it is encouraged to link the research further to find new insights.

For example, by complementing this work with quantitative research. With quantitative data, the statements can be further confirmed or refuted, which can help researchers and companies advance the implementation of AI in German SMEs.

Future research can utilize the TOE framework described in this study to conduct more detailed analyses of CSFs in the adoption of AI in SMEs. Conducting longitudinal studies could provide valuable insights into the evolution of these factors over time. In addition, conducting in-depth case studies with individual SMEs would provide a more detailed understanding of the practical challenges and successes of AI integration and provide rich, context-specific insights that could inform best practices and strategic recommendations.

In addition, research could compare the status of SMEs from other countries to derive implications for German SMEs or vice versa.

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Appendices

Appendix A: dp.platform

Link to the platform: <https://dp-plattform.de/view/index.php?p=home>

Link to the project: <https://dp-plattform.de/view/index.php?p=projekt&page=564>

Project Overview: AI-Driven Supply Chain Optimization for SMEs

Objective

The AI-Driven Supply Chain Optimization project aims to revolutionize supply chain management in SMEs by leveraging AI technologies. The primary goal is to enhance efficiency, transparency, and sustainability within the supply chain using advanced AI-driven solutions.

Background

SMEs often encounter significant challenges in managing complex supply chains due to limited resources and technological capabilities. This project addresses these issues by providing a comprehensive digital platform that integrates AI to optimize various supply chain functions, enabling SMEs to streamline operations and improve decision-making processes.

Key Features

- **AI-Integrated Supply Chain Management:** Combines procurement, inventory management, logistics, and sales into a single digital platform powered by AI.
- **Predictive Analytics:** Utilizes AI to forecast demand, optimize inventory levels, and predict supply chain disruptions.
- **Real-Time Monitoring:** Implements IoT devices and AI algorithms to provide real-time tracking and analysis of supply chain activities.
- **Sustainability Insights:** Offers AI-driven tools to monitor and report on the environmental impact of supply chain operations.
- **Collaborative AI Tools:** Enhances communication and collaboration between suppliers, manufacturers, and customers through AI-powered interfaces.

Implementation Strategy

1. AI Technology Integration:
 - Deploying cloud-based AI solutions for data storage, processing, and analytics.
 - Using AI algorithms to analyze data from IoT sensors and other sources in real-time.
2. User Training and AI Support:
 - Providing comprehensive training programs for SME employees to effectively utilize AI tools.
 - Offering ongoing technical support and AI optimization services.
3. Pilot Programs:
 - Initial implementation in selected SMEs to gather feedback and refine AI algorithms.
 - Gradual rollout to a broader range of industries and SMEs with iterative improvements.

Benefits

- **Enhanced Efficiency:** AI streamlines supply chain processes, reducing delays and improving productivity.
- **Improved Decision-Making:** AI provides actionable insights through predictive analytics and real-time data.
- **Sustainability:** AI helps SMEs track and reduce their environmental impact through optimized resource use.
- **Cost Savings:** AI-driven optimization of inventory and logistics leads to significant cost reductions.

Challenges and Solutions

- **Data Integration:** Ensuring seamless integration of data from various sources. The project utilizes standardized data formats and AI-powered data processing.
- **User Adoption:** Overcoming resistance to new technology is addressed through extensive training and user-friendly AI interfaces.
- **Initial Costs:** High initial costs are mitigated by demonstrating long-term savings and offering flexible payment options.

Conclusion

The AI-Driven Supply Chain Optimization project represents a significant advancement for SMEs aiming to modernize their supply chain operations. By leveraging AI technologies, the project not only improves operational efficiency but also supports sustainability and competitiveness in the global market.

Appendix B: Interview Guide – Managing Director

Introduction and Consent:

- Introduce myself and my role in the research.
- Briefly describe the purpose of my research.
- Clearly state the research objectives and what I aim to achieve.
- Explain the significance of their input in contributing to the research.
- Explain the structure and duration of the interview.
- Request consent for recording the interview.
- Ensure the interviewee understands that their responses will be anonymized.

Company and Interviewee Background:

- Ask about the interviewee's role and experience in the company.
- Gather information on the company's size, industry, and general approach to AI.
 - Industry: "What industry is your company in?"
 - Number of Employees: "How many employees does your company have?"
 - Revenue: "What is your company's annual revenue?"
 - Position: "What is your position in your company?"
 - Years of Experience: "How many years of work experience do you have in total?"
 - Years of Experience with AI: "How many years of experience do you have specifically with AI?"

Questions for guidance

AI use and implementation

1. AI application: "How do you use AI in your company and for what specific purposes?"
2. Main users: "Who are the main users of AI in your company and how has this affected their work?"

3. Technology integration: “Can you describe how AI technologies have been integrated into your existing systems and processes?”
4. Operational impact: “In what ways has AI impacted your operational processes and what benefits have you observed?”
5. Challenges in the introduction of AI: “What challenges have you encountered in the integration of AI and how have you addressed them?”

Organizational culture and AI introduction

6. Description of the corporate culture: “Can you describe the culture of your company? Which aspects do you find most influential?”
7. Positive contribution of culture: “Which values or factors of your corporate culture contribute positively to the introduction of AI?”
8. Negative cultural factors: “Are there aspects of your corporate culture that pose challenges to AI adoption?”
9. Expected cultural changes: “Do you see any changes in your corporate culture as critical to improving the use of AI in the future of your business?”

Strategic and environmental factors

10. Leadership and AI: “How does leadership influence the direction and success of AI initiatives?”
11. Strategies for AI competence: “What strategies are there to develop or acquire AI-related skills?”
12. Resource allocation: “How are resources allocated to AI projects in your organization?”
13. Navigating the regulatory environment: “How have regulations influenced your AI adoption and strategy?”
14. Market influences: “How do market dynamics and competition influence your approach to AI?”

Future directions and personal insights

15. Emerging technologies: “What emerging technologies or trends do you plan to adopt?”
16. Vision for AI: “What is your long-term vision for AI in your company?”
17. Future challenges and opportunities: “What challenges and opportunities do you see for AI in your industry?”

18. Advice for AI adoption: “What advice would you give to other organizations looking to adopt AI?”

19. Reflections on AI misconceptions: “What misconceptions about AI have you encountered and how have you addressed them?”

20. Expected changes in roles: “How do you see AI influencing roles in your organization in the future?”

Additional insights

21. Lessons learned: “What important lessons have you learned through the process of introducing AI?”

22. Cultural adaptations for AI: “What cultural adaptations were necessary to facilitate the integration of AI?”

23. AI's role in strategy: “How is AI integrated into your broader business strategy?”

24. Measurement of AI success: “How does your company measure the success of AI initiatives?”

25. Technology adoption challenges: “What barriers to technology adoption have you experienced and how have these been overcome?”

Final questions

26. Global trends: “How do global trends influence your AI strategies and initiatives?”

27. Customer expectations: “How have customer expectations driven your AI innovations?”

28. Impact on operational processes: “Can you give specific examples of the impact of AI on operational efficiency?”

29. Societal impact of AI: “How does your company consider the societal impact of AI applications?”

30. Final thoughts: “Are there any other insights you would like to share about fostering a culture that supports AI adoption?”

Appendix C: Interview Guide – Consultant

Introduction and Consent:

- Introduce myself and my role in the research.
- Briefly describe the purpose of my research.
- Clearly state the research objectives and what I aim to achieve.
- Explain the significance of their input in contributing to the research.

- Explain the structure and duration of the interview.
- Request consent for recording the interview.
- Ensure the interviewee understands that their responses will be anonymized.

Company and Interviewee Background:

- Ask about the interviewee's role and experience in the company.
- Gather information on the company's size, industry, and general approach to AI.
 - Industry: "What industry is your company in?"
 - Number of Employees: "How many employees does your company have?"
 - Revenue: "What is your company's annual revenue?"
 - Position: "What is your position in your company?"
 - Years of Experience: "How many years of work experience do you have in total?"
 - Years of Experience with AI: "How many years of experience do you have specifically with AI?"

Questions for guidance

AI usage and implementation in organizations

1. AI applications at clients: "How have the organizations you have worked with used AI and for what specific purposes?"
2. Main users in client organizations: "Who are the main users of AI in these organizations and how has AI impacted their work?"
3. Integration of the technology: "Could you describe how AI technologies have been integrated into your clients' existing systems and workflows?"
4. Operational impact on customers: "What impact on operational processes have you observed in organizations that have adopted AI?"
5. Challenges in AI adoption: "What challenges did your customers face when integrating AI and how were these addressed?"

Organizational culture and AI adoption in organizations

6. Description of organizational cultures: "How would you describe the cultures of the organizations you have worked with in terms of supporting AI adoption?"
7. Positive cultural contributions: "What cultural values or factors have you observed that contribute positively to AI adoption in these organizations?"

8. Negative cultural factors: “Are there aspects of your client's organizational culture that pose challenges to AI adoption?”

9. Expected cultural changes to improve AI use: “From your perspective, what cultural changes are critical to improve the use of AI in the future of your customers?”

Strategic and environmental factors influencing AI adoption

10. Leadership influence on AI projects: “How has leadership influenced the direction and success of AI initiatives in the organizations you have worked with?”

11. Strategies for developing AI skills: “What strategies do organizations commonly use to develop or acquire AI-related skills?”

12. Resource allocation for AI projects: “How are resources allocated for AI projects in the organizations you advise?”

13. Dealing with regulatory impacts: “How have regulations impacted your clients' AI adoption and strategies?”

14. Market influences on AI strategies: “Can you discuss how market dynamics and competition influence your clients' AI adoption strategies?”

Future directions and personal insights on AI

15. Emerging technologies: “What emerging technologies or trends are your clients planning to adopt based on your advice?”

16. Long-term vision for AI: “What are your clients' long-term visions for AI within their organizations?”

17. Future challenges and opportunities: “What challenges and opportunities do you see for AI in the industries you serve?”

18. Advice for AI adoption: “Based on your experience, what advice would you give to organizations looking to adopt AI?”

19. Reflections on AI misconceptions: “Have you identified common misconceptions about AI in your consulting work and how have you advised your clients to deal with them?”

20. Expected changes in roles due to AI: “How do you see AI affecting roles in the organizations you work with in the future?”

Additional insights

21. Lessons learned from different projects: “What important lessons have you learned from AI adoption projects in different organizations?”

22. Cultural adaptations for AI: “What cultural adaptations were necessary for organizations to facilitate AI integration?”
23. Integration of AI into business strategies: “How is AI integrated into the broader strategies of the organizations you advise?”
24. Measuring AI success: “How do your clients measure the success of their AI initiatives?”
25. Technology adoption challenges: “What barriers to technology adoption have you observed and how have these been overcome?”

Closing questions

26. Global trends influencing AI strategies: “How are global trends influencing AI strategies in the organizations you advise?”
27. Client expectations and AI innovations: “How have client expectations driven AI innovations in your consulting experience?”
28. Impact on operational efficiency: “Can you give specific examples where AI has significantly impacted operational efficiency?”
29. Consideration of the societal impact of AI: “How do your clients consider the societal impact of their AI applications?”
30. Final thoughts on cultivating an AI-adaptive culture: “Are there any other insights you would like to share about fostering a culture that supports AI adoption?”

Appendix D: Interview Summary – Results

Description of AI		
#	Interviewee ID	
AI1	K	As a huge opportunity.
AI2	K	It's like a crane on a building site. The crane doesn't know where to put what either. So somehow the human has to do it. But of course it exponentially increases the load that I can transport, the speed at which I can set something up.
AI3	G	AI is an intelligence that virtually learns by itself.
AI4	N	Artificial intelligence is the study of intelligent problem-solving behavior and the development of intelligent computer systems and deals with methods that enable a computer to solve tasks that, when solved by humans, require intelligence.
AI5	O	What you can say is that the goal is actually to use AI to act as a co-pilot.
AI6	P	I would define AI as a computer or computer performance that acts like a human and can reproduce or produce behavior and working methods independently.
AI in Context of SMEs & Digital Transformation		
#	Interviewee ID	
DT1	A	AI is a clear part of the digital transformation, but we are mainly a craft business, so it doesn't really play a role at the moment. We're too small for that.
DT2	D	AI is a tool within the digital Transformation.

DT3	E	Let's put it this way, the broad SME sector won't jump on the bandwagon immediately and will first see what the big companies are doing.
DT4	F	Artificial intelligence can play a decisive role in our industry. In Germany, demographic change is one of the issues we face, but we still want stable economic growth. AI, which also promotes autonomous driving, can be a turning point for us.
DT5	G	AI is the tool to simply bring the topic of digitalization forward.
DT6	H	So I don't think there's any fear that this could somehow replace jobs or anything like that.
DT7	I	As a German medium-sized company, we want to use AI to be more than just a hidden champion, which brings a lot of opportunities for us in the digital transformation.
DT8	K	We are in such a permanent digital transformation, especially now with AI.
DT9	L	For many German SMEs, AI is both a huge opportunity and a threat. In the context of digital transformation and all the problems we have, there are opportunities to grow even further.
DT10	N	Especially in the operational area, AI is a super exciting and unavoidable topic and an accelerator for tackling the problems of digital transformation. German SMEs in particular can leap over a major hurdle with smart investments.
DT11	O	It is foreseeable that companies that successfully invest in AI will have a greater competitive advantage in the long term than those that do not.
DT12	P	A future-oriented company should see AI as a building block for long-term success. And this is precisely the opportunity for German SMEs. In times of digital transformation, the topic of AI must be put on the table as early as possible.
Use Cases of AI		
#	Interviewee ID	
UC1	A	I use AI from time to time to write texts, I could have used it earlier as a student.
UC2	B	We often use ChatGPT because it has simply become a super common and practical tool in everyday life for various marketing aspects, be it text or image generation, as well as the search engine.
UC3	C	When we look at new markets, we often use it to do initial research for them. We use Microsoft Copilot and its various applications, be it for mail or calendars.
UC4	D	We don't have any use cases at the moment, but I think there will be some exciting things for us in the future. I think there will soon be AI-based software for us that can help us optimize the tools, for example in the use of materials to make the tool as functional but as light as possible.
UC5	E	The use of AI is already very attractive, especially in the area of marketing, be it text creation or image and video creation, for us too.
UC6	E	I suspect that many things would probably already be possible now, but that people don't really dare to do them yet.
UC7	F	On the one hand, it is about autonomous driving, but also for the operational business itself, for example the most efficient planning of journeys.
UC8	G	The next topic is in the area of reporting, such as the sustainability report, ESG report, and also in the whole area of customer support, i.e. customer service. AI can easily answer all these questions.
UC9	G	If we consider using AI for training videos, which we have, we can also say that more videos will simply be produced in which voices have been recorded, the avatars will also be used to train companies.
UC10	H	We use AI in combination with the ERP system, so if there are AI-generated dashboards or tools like that, it can also make day-to-day work more efficient.
UC11	H	It is also a topic in the area of social media, and in the future it can certainly also be used to find ideas for content.
UC12	H	I know that our competitors have a swimming pool control system that is supposed to be AI-based and that also somehow incorporates weather data, for example, so that if it rains, for example, you can do a quick backwash beforehand, then you can replace the water that you have flushed into the sewer with rainwater, so it doesn't have to be topped up with so much tap water, things like that.

UC13	I	Of course, we have already integrated AI across all possible Microsoft applications, everyone is free to use it and our mechanics have the latest AI plug-ins for their product software.
UC14	J	Formulation of emails, translations, as an optimized search engine, processing and analysis of data, data maintenance, that's how it started with AI in our company.
UC15	J	So there are so many business cases, for example a very simple customer service contact, if I want an invoice from the company, if I want to register a return. This and more can be done by an AI Chatbot.
UC16	K	So far, it's been a lot of trying things out and seeing what's available. And you always have this moment, this FOMO moment, there's always something new and now we're moving more towards concentrating on saying, let's really put the first things into an operational application. I personally work with chat GPT all the time. That's actually, so Chat-GPT4, that's actually what I use, a bit of a sparring partner. As a managing director, I often use it to get inspiration.
UC17	K	We already use it in part to analyze data. ... The AI can help you very well to sort the data in a table according to positive and negative and to search again to see whether there are thematic clusters that appear again and again, both positive and negative.
UC18	K	Wherever we have points of contact with customers, for example, in terms of communication, be it via chatbot or email, AI can of course be used to streamline communication.
UC19	K	In the area of unstructured data, if we can record and structure it, we can simply manage to crystallize and streamline the requirements and answer them accordingly without having to manually intervene and thus shorten the operational processing time.
UC20	L	Within Europe, we have built the first steel machine that works based on AI. This machine is still the market leader.
UC21	M	This is a super exciting topic in health and biotechnology, for example image recognition, which can be used to detect cancer more quickly.
UC22	N	AI-supported software for streamlining entire supply chains or even within individual departments, be it purchasing software or sales software for the sales service, offers enormous potential for increasing productivity.
UC23	O	In the strategic area, we are talking about a negotiation chatbot. This is a negotiation bot that makes it possible to enter into negotiations with multiple suppliers at the same time and also has a sentiment analysis function. This means that based on the words that the supplier enters, based on the reaction time, the choice of words is also controlled by the chatbot.
UC24	O	In the operative purchasing area, we are talking about the automation of e-mail inboxes of operative purchasers. This means that they should not only process orders, check order confirmations or invoices, query statuses and so on, but we also see massive savings potential here when it comes to simply automating the work of operational buyers by handling various documents that need to be processed with the support of AI.
UC25	P	In the area of strategy, large language models are particularly interesting, as they can help you with initial ideas or provide some structure. But of course it doesn't work on its own. But I often use it as a basis, even for research.

#	Interviewee ID	Data	Infrastructure	Compatibility	Technological
T1	A	-	-		I also do a lot of project planning myself, but we have nothing to do with data or technological infrastructure here.
T2	B	-			From a technological point of view, I can hardly say anything, as we are a creative profession. We don't have anyone with a technical background in the team, and AI always needs data. We don't collect any data, we work with ideas that are individually tailored to the customer each time.
T3	C	-	-		We are a 6-man company, we have no idea about the technological side. Whether it's about collecting data or the infrastructure, we have little to offer.
T4	C			+	Our computers are compatible with the latest applications and we will see whether there will be other use cases for us in the future.

T5	D	+		+	We have a lot of data about the different tools, so I think someone who knows about AI might be able to use it to optimize them. We don't really need to make any major changes, we're a super small company without our own IT. The integration should certainly work for us at some point.
T6	E	-			AI is also dependent on a lot of data, I would have to start collecting data from the past. First of all, I don't know how I would have to do that so that it can be used later. We will certainly be able to acquire an AI license for something at some point, but until then we'll see what comes onto the market.
T7	F	+	+		We have software that analyzes data based on AI. This helps us to plan our journeys as efficiently as possible. The day-to-day operations take place in our office, where we have an IT specialist who takes care of the technological infrastructure and, of course, electronic data processing in general.
T8	G		+	+	We have around 40 developers in the background to whom we have direct access. If there is a need, we program it ourselves.
T9	H		-		Above all, we have a large sales team and a team for repair services. Technologically, however, we are not very well positioned, so we would certainly need external help.
T10	I	+	+		We are also very well positioned in terms of technology. We have a great developer team and have been collecting our data for years, making us a super digital company that can also act quickly on the technological side. I have to say quite clearly, otherwise we wouldn't be where we are today.
T11	I			+	Through the Microsoft applications or the mechanical software just mentioned, the technological infrastructure has been created, so to speak, and our systems are compatible with the latest applications.
T12	J			+	We are currently developing software for product descriptions based on AI. We are in an okay position within the company, which is why we are doing it together with an external service provider.
T13	J		+		For us, it's really just the developer capacity, that we have experienced developers who can build the entire setup, including the server infrastructure, etc., that is important.
T14	K	+	+	+	We are a very digital company, we have the technological infrastructure and AI is compatible with our systems and processes. We have countless pieces of data, both collected internally and from customers.
T15	L		-	-	We are currently in the process of starting the process internally. To do this, we are digitalizing ourselves and gradually using AI for our production, sales and all other departments and learning how to build our infrastructure and compatibility with our systems.
T16	L	-			What we need to do first is collect data on which we can build. There is still far too much analog in our company.
T17	M	-	-	-	What I have often observed with medium-sized companies is that they invest too little in IT. They have no structures in place to use their data. If they have collected their data at all. The technology is so backward that it is no longer compatible with the latest applications.
T18	N		+	+	German SMEs generally have software that works across departments to a certain extent. You can install an AI plugin in various places, so to speak. This means that the structures are more or less in place in most cases.
T19	N	+			And of course, AI lives from data. In the operations sector, which is very much a supply chain, there is no shortage of data along the entire chain. The SMEs we advise are among the larger companies and mostly have software systems that have been collecting data for years, for example their ERP or purchasing software such as SAP Ariba. The providers are also gradually developing and integrating more AI into their software.
T20	O	-			An AI simply needs data, which has to come from somewhere. And preferably from the company, which is the best way to use AI.
T21	P	-			We need more and more data, because then we can evaluate, benchmark and run through different scenarios even faster. And many companies don't have them, or don't have them the way we would need them.
T22	P		+	+	As a strategist, the technological prerequisite is often what makes or breaks everything. Companies live from data and their infrastructure should be able to integrate AI as quickly as possible. Many strategies are based on this. Fortunately, this is also the case for the size of company that I advise in this context, which tends to be medium sized with up to 500 employees.
Sum		5x + 1 8x -	7x + 1 5x -	8x + 1 2x -	
Organizational					
#	Interviewee ID	Culture	Top Management Support	Readiness	
O1	A	+	+		If something comes up, I can make decisions quickly as the sole managing director and I think that the employees are also willing to learn new things, but in itself it's not an issue at all for now.
O2	B	+			As a marketing agency, you always have to keep up with the times, of course, which is why we hear a lot about what's going on around us. I think we all follow it very closely and see if we can make use of it.
O3	B		+		I'm always open to new things or if I discover something new, I immediately share it with my team.
O4	C		-		Well, it's hardly interesting for us at first. I don't want to replace all my employees with a machine. We're not afraid of new things, but so far it's just not that interesting for our business.

O5	D	-			We are a craft business, so of course we have no interest in AI. For many employees, the threat of losing their job is also a threat.
O6	D		-		We mainly get specialty orders from regular customers, I don't have to make any effort to become an AI pioneer at the moment.
O7	E		+	+	I think it can make everyone a better worker, whether it's me or the master brewer, in principle I think everyone is open to it and I give everyone the opportunity to introduce something new.
O8	F	-			I would say that we have a very inquisitive corporate culture in this respect. We thrive on optimization, and AI is a great opportunity for us. But the drivers won't be thrilled, of course, and see it more as a threat, at least in the long term.
O9	F		+		Of course, I'm trying to lead the way, but I'd say that AI definitely makes us employees in front of our laptops more effective.
O10	G		+		Processes will simply be automated, which has been a problem for years, and then this implementation will also take place and older colleagues will simply have to see where they are left. And that is the art of management, to have a good change process here.
O11	G	-			So the cultural aspect is also one of the biggest challenges in technology adaptation in general.
O12	G			+	Because at the end of the day, AI, depending on the tool, is also more of a non-financial issue. We are always ready, we have a super strong development team that would be ready to write an AI system ourselves at any time.
O13	H				We are not ready at all, we currently have other problems to deal with. For example, we have been working on introducing our new ERP system for some time now, but that is still taking time.
O14	H	-		-	In the future, we will also have to start offering employees training and somehow manage to familiarize them with AI so that they can become more productive, more efficient or even, let's say, better with the use of AI.
O15	H				In our company, we have a culture that is rather closed to new things and prefers to stick to the old.
O16	I				Of course, as Managing Director, I would also like to lead the way.
O17	I		+		Any employee who approaches me and has a good idea, I will of course support them and see how we can implement it together.
O18	I			+	We allow everyone to use AI and ChatGPT or similar, but we don't yet have any rules on how we should handle it. I think it's common sense not to upload sensitive data. But maybe we should introduce something internally and wrap it up officially.
O19	J	-		-	The cultural issue is probably the most critical for us. So far, it's still more of an IT and nerd topic. But we are trying to pick up more and more employees with regular information events. Otherwise, employees will certainly have to leave in the long term or we will have to look for new tasks for them.
O20	J				We do not prevent it technically, but organizationally, because we first want to define how we use it.
O21	J		-		As Managing Director, I also drew attention to the issue early on. I can't always know everything, so employees can make suggestions to me on this point at any time, and we then try to implement them together.
O22	J			See O19	I don't think we would have so many technical and organizational challenges, we could manage it all with the skills we have in the company. Ultimately, it's just a question of having the manpower available.
O23	K				This is not just to do with chemistry, it is a fundamental cultural issue in a company where change is not seen as a threat, but always as an opportunity.
O24	K		+	+	So we have had an extreme cultural process in the last four years and have changed a lot, and one of our values is courage. And we have also made this visible with a few campaigns here at the company. So there are questions hanging in our meeting rooms, which are then again based on our values.
O25	K	+			We invite people who regularly raise awareness of this topic, simply to signal that we need to deal with it.
O26	K				And the other level is that I have a colleague who is very familiar with this topic, who I have put this hat on, so to speak, and who has now taken on a dozen or so colleagues across all departments who enjoy trying out this AI topic with us. And we have then equipped them with the software they need or the tools they need.
O27	L	-		-	Most people say it's best not to change anything. It's also frightening how stupid some people are sometimes, we would be better off being driven by AI. You can count on two hands the number of people who are interested and are pushing things forward. That makes it difficult to implement anything in this area.
O28	L		-		To be honest, the communication is also 100% my fault, I would have to communicate this differently to the employees and point it out more. But as stupid as it sounds, it works anyway, as stupid as it sounds... but I have to work on that in the future.
O29	M		-	-	In my experience, it's a 50/50 thing, the industry thrives on innovation. SMEs have a really hard time competing with the big companies, but they have to take a risk. This means that the company management must be aligned in this direction, the necessary resources must already be in place and the entire culture must be involved. And mostly, it isn't the case.
O30	N			-	Digitization is a big topic in the operations sector, everyone wants to move away from analog. Companies that have this business are also ready for AI because it naturally makes work easier and increases efficiency.

O31	N	-			But culture is a thing of its own; some companies are already struggling with digitalization, but there's no future in that.
O32	O	-			The challenges we see are primarily cultural.
O33	O		-		Of course, there must also be a commitment from the top level that AI can be used, that no barriers are placed in the way so that implementation can take place.
O34	P	-			Culture is definitely the biggest barrier to implementing AI.
O35	P		-	-	But to create the right culture, management must take the first step and lead the way. This also includes creating the right personnel and resources. Many SMEs are currently in this process.
Sum		4x + 1 9x -	7x + 1 7x -	4x + 1 6x -	
Environmental					
#	Interviewee ID	Ethical and Moral	Regulations and Legal Frameworks	Competition and Market Pressure	
E1	A		-	+	We have a very good order situation and, given our size, a lot is done through our regional network, so we don't need to compare ourselves with others. And I don't tell my employees what to do, we rather benefit from it. Anyone can test what works, but I should think about the issue of sensitive data.
E2	B			+	We are a small, regional company. We are a leading company in the area and don't even look at what others are doing in terms of AI. The topic is too little present for that.
E3	B	-			When you use AI, especially for content creation, the ethical and moral question naturally arises at some point. How far can you go? I think the topic is only just developing into something really big, we still have a very human touch, but we are definitely keeping a close eye on it.
E4	C	-	-		This is less specific to us now, but I would like the government to create a framework for the development and use of AI, otherwise there will soon be heated ethical and legal discussions.
E5	D			-	I can well imagine that larger and more commercial companies are already integrating something into their production or operational business.
E6	D	-			For me, it is also a moral question at a certain point whether I would let an employee go today to be replaced by a machine, an artificial intelligence.
E7	E			-	We are currently looking very closely at what the big international companies, the market leaders, are doing. In our industry, it is often the case that they innovate and later commercialize something. With software, for example. They set up a new company from within the company and then sell their solutions to smaller companies like us.
E8	E	-	-		In principle, a discussion would also be necessary as to whether we disclose all data. This is how the model learns, and we can also learn from our competitors, but competitors can also learn from us.
E9	E			See E7	We simply cannot and do not want to take the risk that other companies, especially larger ones, can.
E10	F			-	Of course I look at how the competition is doing, there are 3 other companies of a similar size in the area and of course we talk about AI, nobody wants to be left behind.
E11	F	-	-		For me, the question may then arise at some point as to whether I should let employees go and have an autonomous truck, for example. If there is an economic incentive for this, it will cost many people their jobs. And it's not just about drivers, it's also about us office workers. How far do you go then?
E12	G			+	We have a very good market position and a great product, everyone is trying to write AI on their banner, but we are very relaxed about it and feel no pressure. We do our thing.
E13	H				So I think if the pressure is there, we will certainly be able to adapt.
E14	H			+	I think that's perhaps also a bit of a barrier to entry, that it just happens so quickly and somehow you can't keep up with it.
E15	I	+	+		For us, no moral questions have yet arisen, we see AI as a co-pilot in all kinds of areas, and that's how everyone uses the Mag, without any regulations so far.
E16	I			+	We look very closely at what is happening on the market, in the world, otherwise we would not be where we are today. We are a top modern company, also because we are so technology-driven. We keep a very close eye on what is happening.
E17	J				Of course, we have to be extremely careful not to upload any sensitive data there. Our employees have been made aware of this and have also signed something.
E18	J		+		The colleagues have now drafted a guideline for us internally, which also clarifies legal issues, data protection concerns and The colleagues also realized very, very quickly that the machine is not yet ready to take on complex issues, but that we have to invest a lot in it.
E19	J			-	We haven't felt any competitive pressure yet, we are in a comfortable situation, but in our business you have to keep an eye on the competition and also start-ups, as they can scale super quickly.
E20	K		+		We all have ChatGPT Pro access for our own employees, so I think every employee is aware of what data they can and cannot upload.
E21	K				We also have a lot of regulatory requirements from customers, so we are not allowed to upload sensitive and, above all, confidential data.
E22	L			-	The steel industry is very conservative, we are lagging behind like other companies and have no pressure from suppliers and customers.
E23	L		-		No, we don't have any guidelines; as far as I know, the employees don't use them at all.
E24	M			-	As just mentioned, the market thrives on innovation, who will achieve the next breakthrough in research and who will bring the product to market the fastest? Of course there is pressure.

E25	M	-	-		The only question then is, when it comes to responsibility, to what extent do you trust artificial intelligence more than a human being? After all, making the wrong decision can have extremely damaging consequences. So far, the market has been very heavily regulated. The legal regulations are very strict and don't leave much room for maneuver, especially in Germany.
E26	N		-		So there are some customers who, for example, have completely banned ChatGPT for employees who are not allowed to use it.
E27	N			-	There are constantly new regulatory requirements for companies, such as the LkSG or the CSRD. This is a huge amount of work for companies, and AI can of course help to deal with this more quickly.
E28	N				To become as efficient as possible, AI is essential in operations, and the competition never sleeps. Those who act quickly here will be successful in the long term.
E29	O		-	-	Because they ultimately want to retain control over the data. And the competition should not benefit from this.
E30	P		+	+	I think you can make incredible efficiency gains if you dare to exchange data with each other.
Sum		1x + 1 6x -	4x + 1 8x -	6x + 1 8x -	

Other Comments		
#		
X1	E	You have to be prepared to take a certain amount of risk, because you need budget to set it up.
X2	F	We had an external agency that helped us with this, but two colleagues essentially drove the issue internally.
X3	H	So I think for us in the company, for the future, it is certainly an issue. To what extent, of course, is still difficult to say. Or in which areas.
X4	I	So if we build it, then it would also be something that you could say you really sell as a tool to external parties.
X5	K	Everyone is just trying it out and at some point this big blubb comes and then there are the really cool, big applications.
X6	K	Very few people have an idea without having been inspired.
X7	L	There is still a lot to come, for sure, but right now we don't even know what will happen. You can't be closed-minded about it all and you have to be careful.