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ARTIFICIAL INTELLIGENCE FOR SMALL AND MEDIUM-SIZED ENTERPRISES

Challenges During the Implementation Process & How to Overcome Them

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ABSTRACT

Small and medium-sized enterprises (SMEs) are the engine of the German economy. At the latest since ChatGPT & Co. have been shaking up the markets, it is clear that they are not spared from digitalization and new technologies - quite the opposite. Using these new technologies opens a wide range of opportunities for SMEs. Artificial Intelligence (AI) is taking up an elementary role in the path toward an innovative economy.

AI can solve abstract tasks and problems based on the computational force that would otherwise require the intelligence of a human being.

This technology has long ceased to be a trend and is becoming increasingly important for ensuring the future competitiveness of small and medium-sized enterprises. Those companies are able to adapt quickly to technical innovations, such as AI, due to short decision-making phases.

But why do SMEs still find it challenging to transform with AI?[1]

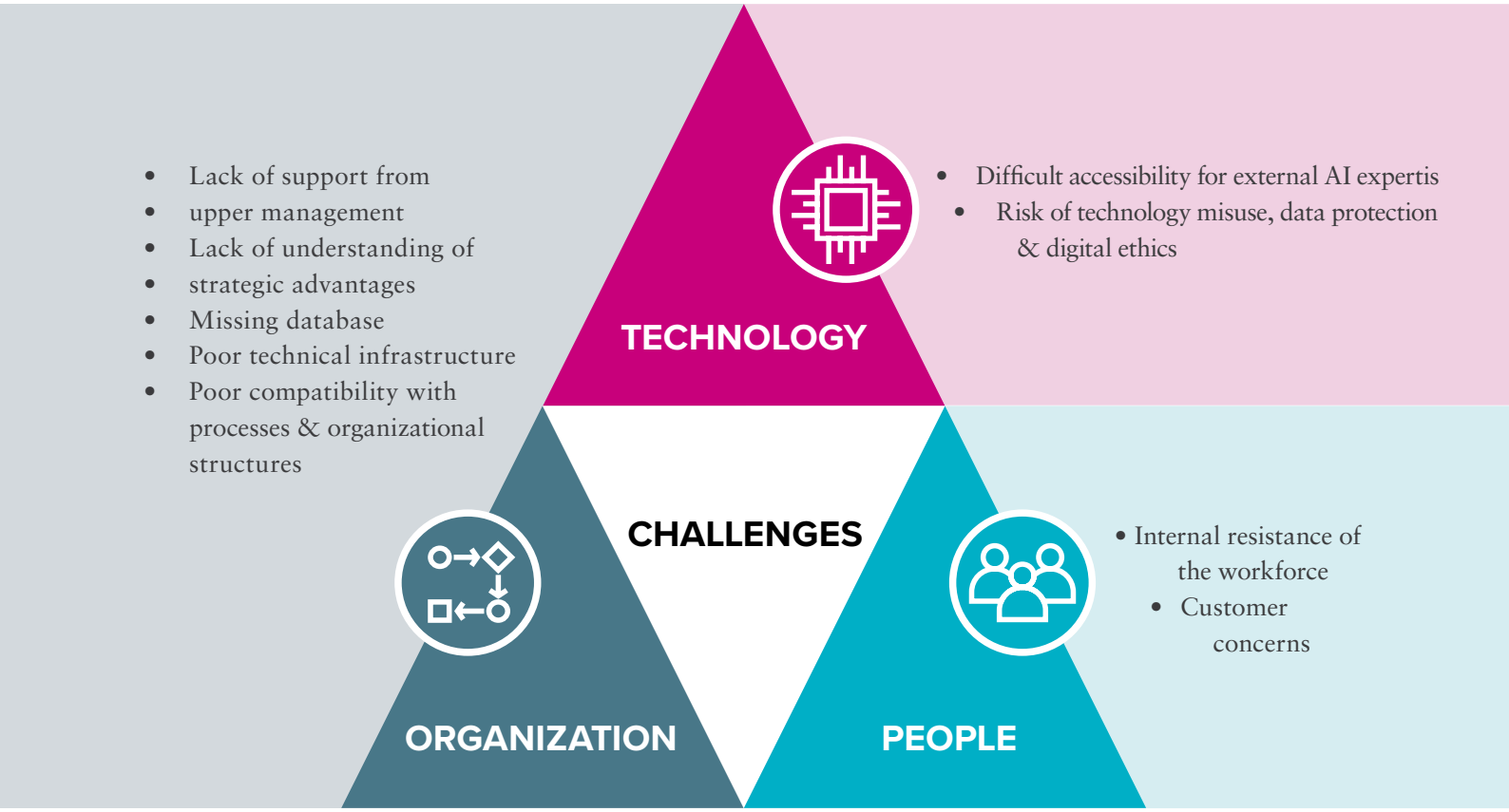
This paper aims to identify possible technological, legal, economic, and social challenges of AI implementation for SMEs and derive solutions, as well as recommendations for overcoming the identified obstacles. For this purpose, AI experts were interviewed qualitatively, and experience reports from SMEs, which had a history with AI technology, were collected and analyzed. Taking the current literature into account, the potential of AI for SMEs was highlighted, core implementation challenges were identified, and suitable recommendations for action were presented.

The authors conclude that while the obstacles challenge SMEs, they are surmountable, and this disruptive technology is worth the effort.

1 German Economic Institute (2021)
https://www.iwkoeln.de/fileadmin/user_upload/Studien/Kurzberichte/PDF/2021/IW-Kurzbericht_2021-KI_in_KMU.pdf

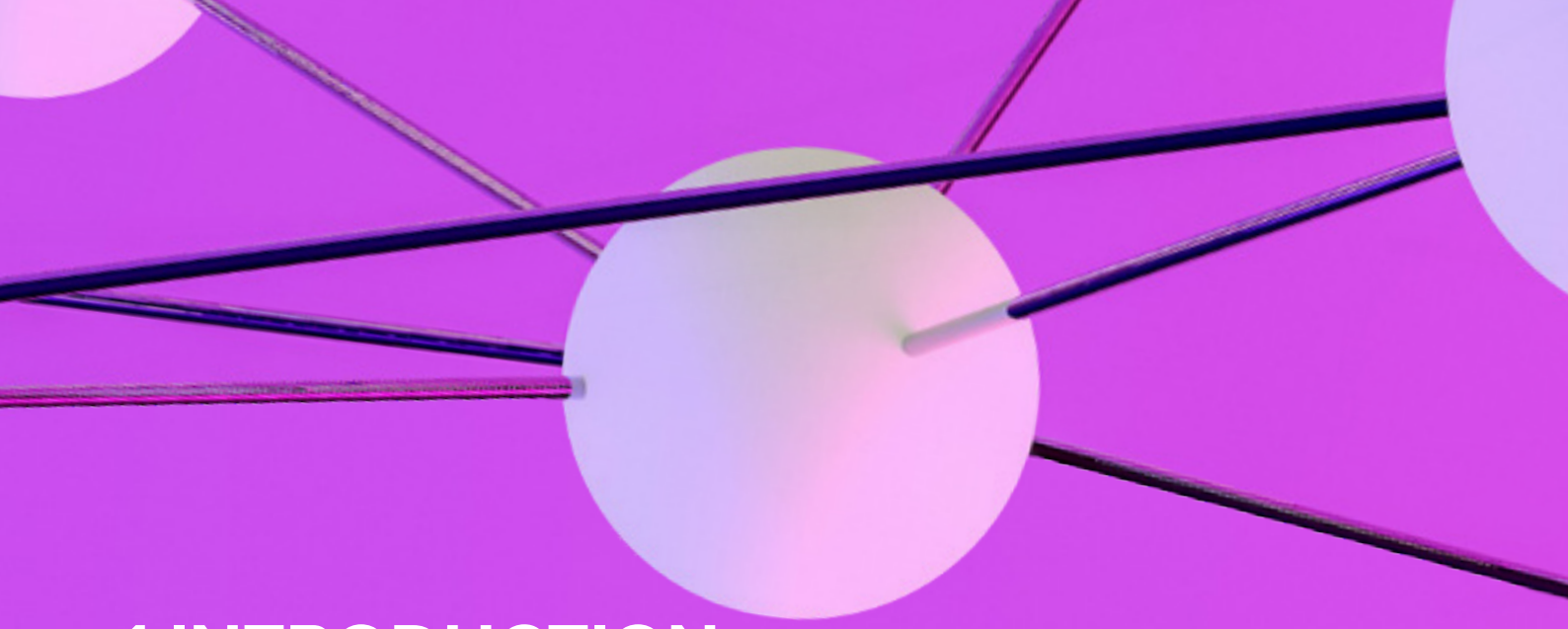
POTENTIAL

- Quality assurance through error minimization
- Increasing productivity and efficiency through automation
- Employee satisfaction through the reduction of monotonous manual tasks
- Improvement of customer relations through individual offers
- Competitive advantages



RECOMMENDATIONS FOR THE IMPLEMENTATION OF AI:

1. Acquire a basic knowledge of AI as a prerequisite for success
2. Establishing a team and/or commissioning consultants
3. Establish clear objectives, design feasibility and potential analyses
4. Take employees' concerns seriously, educate them and turn those affected into participants
5. Create necessary data infrastructure inside the company
6. Implement and scale AI



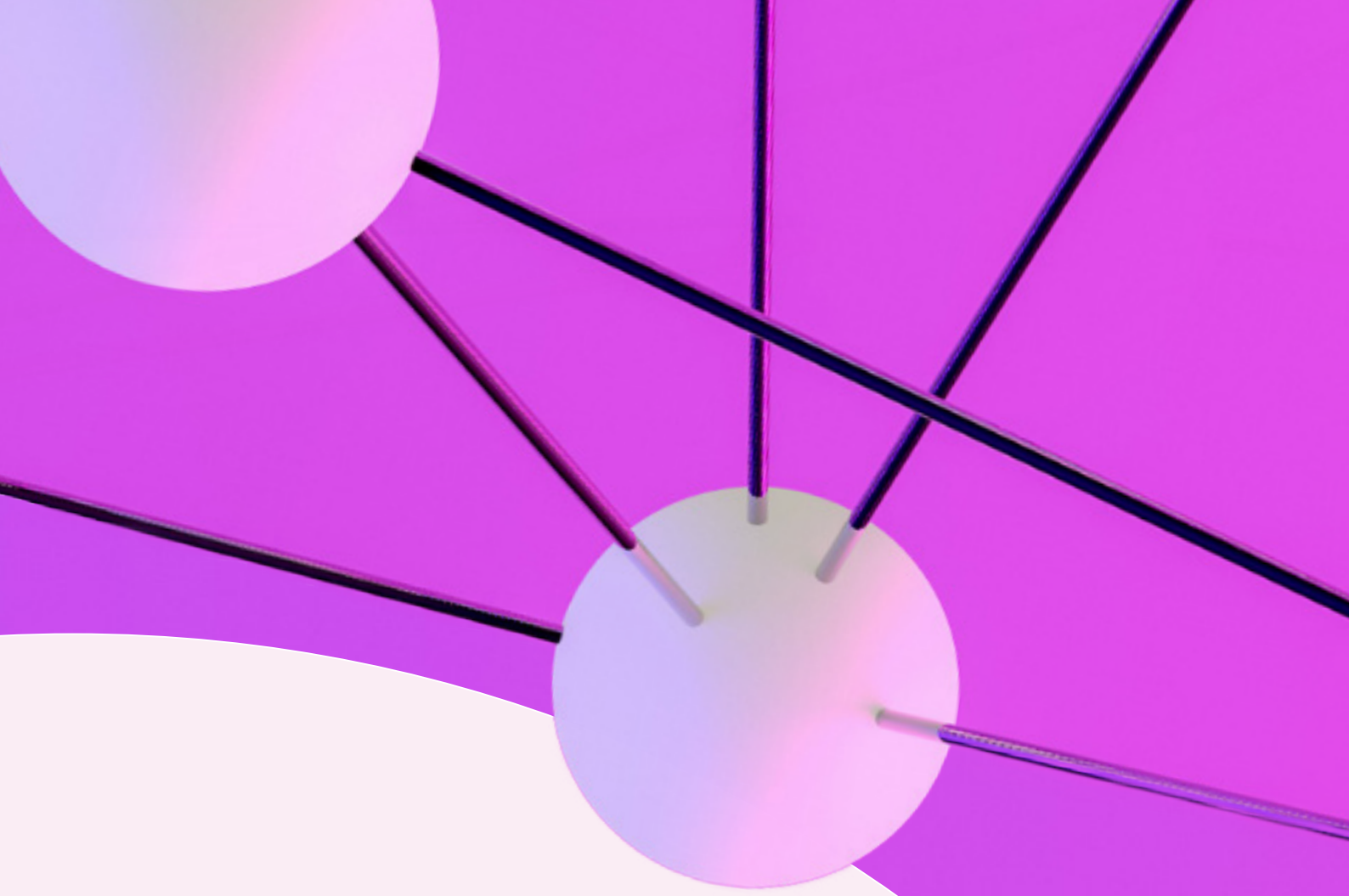
1 INTRODUCTION

Artificial Intelligence (AI) has long been part of our lives

Artificial Intelligence has become part of our lives from the use of navigation systems, voice assistants to automatic parking aids. Thanks to facial recognition, all it takes to unlock our smartphone safely is a quick glance. Those examples make it clear that AI is becoming a crucial part of our professional as well as personal lives.

AI enables computers to independently solve abstract tasks and problems that would otherwise require the intelligence of a human being.[2] Experts are convinced that AI will be as disruptive as electricity, or the internet have been in recent history.[3]

2 PSL booklet, pp. 6
3 Stephan Mayer (2019), https://t3n.de/news/ki-plattform-mittelstaendische-1237323/, aufgerufen am 12.05.22



Today, countless devices are already connected via the Internet of Things (IoT), generating enormous amounts of data (Big Data), which enables the usage of AI in the first place. Artificial neural networks can be generated with new, powerful hardware, delivering even faster results.

In the current competition between companies, AI plays a crucial role. Top executives predict a risk of business failure if companies do not implement AI in the next five years.[4] One thing is for sure: AI is changing not only the business models of large corporations but also those of small and medium-sized enterprises (SMEs). But what are the exact implications for SMEs?

AI will play an increasing role in almost all industries while providing a fundamental impetus for new business models and challenge the existing situations of the various industries with many new ideas.[5] Thus, the implementation of future technologies, such as AI, is becoming increasingly important for SMEs to ensure future competitiveness. [6] This opportunity cannot be missed. But why do SMEs still find it challenging to implement AI?

4 https://www.accenture.com/_acnmedia/Thought-Leadership-Assets/PDF-2/Accenture-Built-to-Scale-PDF-Report.pdf#view=50, retrieved on the 18th of July in 2022
5 https://www.appliedai.de/de/hub/the-elements-of-a-comprehensive-ai-strategy-1-1, retrieved on the 18th of July in 2022
6 Demary and Goecke (2021), p. 2

2 ARTIFICIAL INTELLIGENCE

and its potential

2 ARTIFICIAL INTELLIGENCE
and its potential

2.1 WHAT DEFINES "AI"?

> *Artificial Intelligence is the study of how to get computers to do things that humans, at the moment, are better at."*
>
> – Elaine Rich, Computer Scientist, 1983

AI enables computers **to independently solve abstract tasks and problems that would otherwise require the intelligence of a human being.**[7] The unique feature here is that, unlike classic software, AI does not use a fixed pre-programmed solution path.[8] Instead, self-learning algorithms are used to independently analyze and interpret data and make decisions based on it. This is referred to as learning systems because AI is capable of learning and applying empirical knowledge to new situations.[9] Examples include machine translation, chatbots, image recognition and voice assistance in smart homes.

> *Intelligence is the ability to adapt to change"*
>
> – Stephen Hawking

7 PSL booklet, pp. 6
8 Haarmeier (2021), p. 2
9 German Commercial and Industrial Chamber (Hg., Zeit für den digitalen Aufbruch (2021))

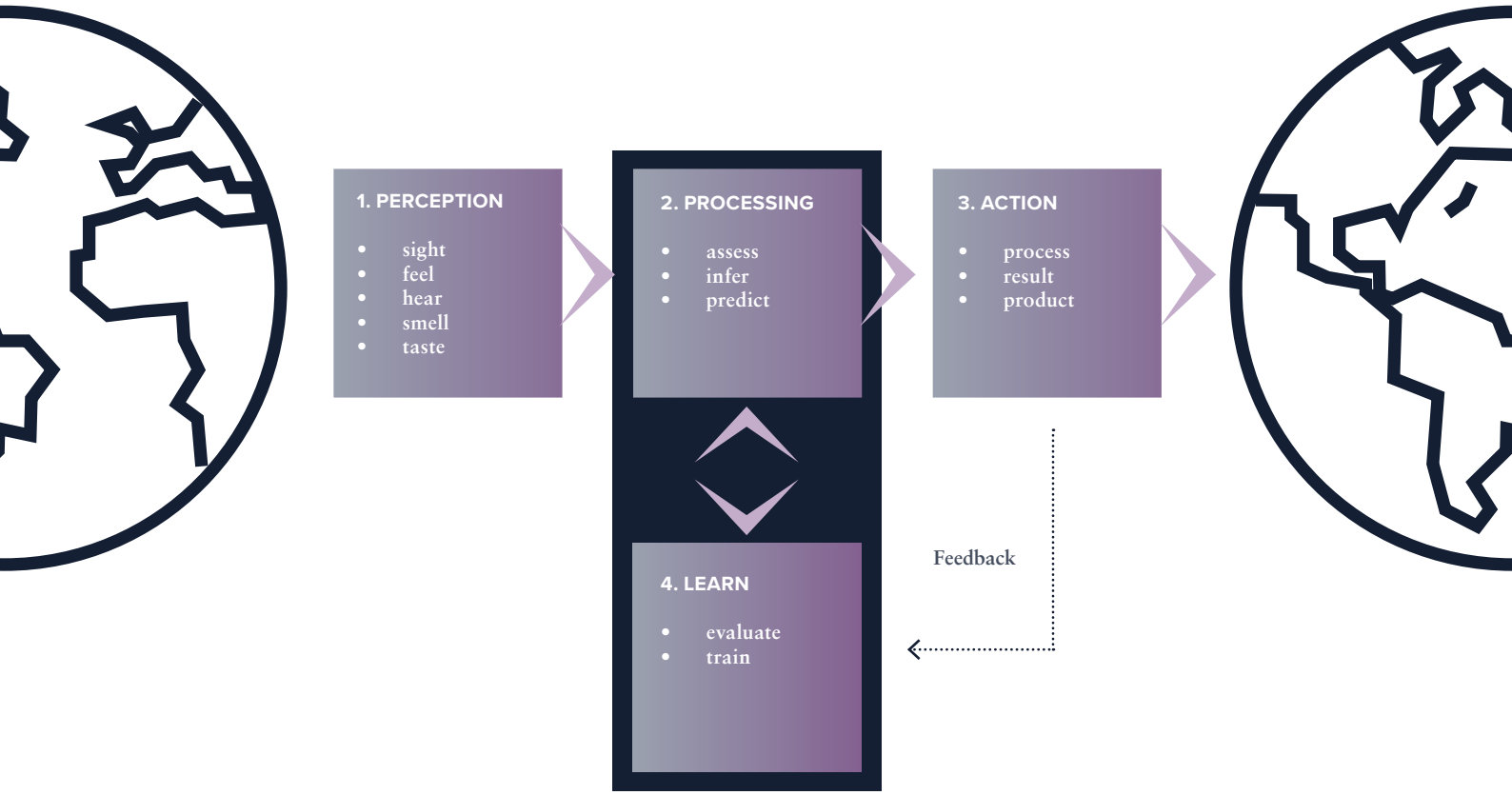


Fig. 1: Functional Mechanism of AI[10]

The collective term AI covers various technologies that can be used for different purposes.[11] The possible operating models can be subdivided into four areas that build on each other:

1. Information is **perceived** from the environment. This is done in a similar way to the human senses via reading, watching, feeling, hearing, speaking[12], smelling [13] und tasting[14].

2. In the next step, the information converted into electronic data is **processed**, evaluated, and conclusions are derived.

3. Based on this, AI can perform a variety of possible **actions** depending on the information.

4. With each processing operation, AI can expand its "experiential knowledge" and **learn** to better process data in the future.

In some areas, the capabilities of AI already exceed those of humans. For example, vectorizing texts provides insights that would remain sealed to "regular" human analytical abilities.[15]

10 Own representation based on Mittelstand Digital (2020), p. 5
11 Hatiboglu et al. (2020b), p. 8
12 Buchkremer et al. (2020), p. 31
13 Nicolotti et al. (2019), p. 21
14 Suganuma et al. (1992), p. 278
15 Buchkremer et al. (2020), pp. 31

2.2 WHAT ARE SMES?

More than 99% of German companies are SMEs, generating about 33% of the total revenue from all companies in Germany. In addition, SMEs provide almost 19 million jobs, which amounts to 55% of all dependent employees.[16] These figures clearly symbolize the significant importance of SMEs for the German economy.

AI will play an increasing role in almost all industries while providing a fundamental impetus for new business models. Thus, implementing this technology will become increasingly relevant for the future competitiveness of German companies, especially SMEs.[17] Therefore, this paper will focus on those companies.

99 % OF GERMAN COMPANIES ARE SMEs

33 % OF REVENUE IS GENERATED SMEs

19 Mio. JOBS ARE PROVIDED SMEs

BUT HOW CAN SUCH A COMPANY BE DEFINED?

SMEs are divided into micro, small and medium-sized companies. The classification is based on two categories, both of which must be undercut:

- Number of employees
- Balance sheet total and annual revenue[18]

16 Institute for Small and Medium Sized Business Research (IfM) Bonn, https:// , retrieved on the 18th of July in 2022
17 Demary and Goecke (2021), p. 2
18 European Commission (2015), p. 11

CATEGORIES	NUMBER OF EMPLOYEES	REVENUE	OR	BALANCE SHEET
Microenterprises	< 10	≤ 2 mill. EUR		≤ 2 mill. EUR
Small-sized enterprises	< 50	≤ 10 mill. EUR		≤ 10 mill. EUR
Medium-sized enterprises	< 250	≤ 50 mill. EUR		≤ 43 mill. EUR

2.3 UNUSED POTENTIAL FOR SMEs

During our series of interviews, the impression emerged was that SMEs, in particular, have reservations about AI. In addition, the limited willingness to communicate by the inquired companies resembles the low priority of this cutting-edge technology. The shallow interest in AI is very high; but, most of the time there appears to be a lack of concrete use-cases or the courage to take risks and surpass individual obstacles.

However, according to most experts, AI has long ceased to be a mere trend. **AI is considered to be very important for the future** of German SMEs.[19] While the usage of AI solutions in Germany has quadrupled from 2 % to 8 % in the last two years, 30 % of companies are already planning and discussing possible use-cases.[20] According to research by "Mittelstand Digital," AI has a high growth potential. More specifically, the AI-induced growth effect alone amounts to an annual figure of 50 billion Euros.[21]

> *Nearly one in four companies plan to adopt AI within the next three years"* [22]
>
> – German Chamber of Industry and Commerce

19 Mittelstand Digital (2020a), p. 15
20 Haarmeier (2021), p. 1
21 Accompanying Research for Mittelstand Digital, p. 4
22 German Commercial and Industrial Chamber, p. 2

AI offers SMEs a **wide range of potential** across all sectors along the entire value chain.[23] Here are a few examples:

EFFICIENCY ADVANTAGES

Automating processes can reduce manual effort and thus cut costs. According to a study by the Frauenhofer Institute, the greatest expectations are placed on the acceleration of processes.[24]

QUALITY IMPROVEMENT

Quality testing of appropriate raw materials by AI enables smoother production lines, quicker and easier processing of different orders and reduced errors.[25]

POTENTIAL FOR ERROR

Increasing the degree of automation in processes, such as the quality inspection of raw materials using image recognition, ensures that production runs smoothly and thus reduces errors.[26]

PRODUCTIVITY INCREASE

Companies can use AI to understand customer behavior through data analysis and optimize their product accordingly.[27]

COMPETITIVE ADVANTAGES

AI can help companies change existing strategies and business models – thus securing essential competitive advantages through innovation.[28]

CUSTOMER BENEFITS

By analyzing historical data, AI can be used to generate offers tailored to the customer automatically.

23 Learning Systems – The Platform for Artificial Intelligence (2021), p. 78
24 Dukino et al. (2020), p. 39
25 MIttelstand Digital (2020b), p. 19
26 MIttelstand Digital (2020b), p. 19
27 MIttelstand Digital (2020b), p. 19
28 Deloitte (2021), p. 411

EMPLOYEE SATISFACTION

AI reduces the workload of manual activities and can thus reduce the workload of employees. This increases the motivation of employees by eliminating time-consuming, monotonous routine tasks. As a result, employees can spend more time on their "real" work. [29, 30]

> *The power of artificial intelligence is so incredible it will change society in some very deep ways ways.*"– Bill Gates, Founder of Microsoft

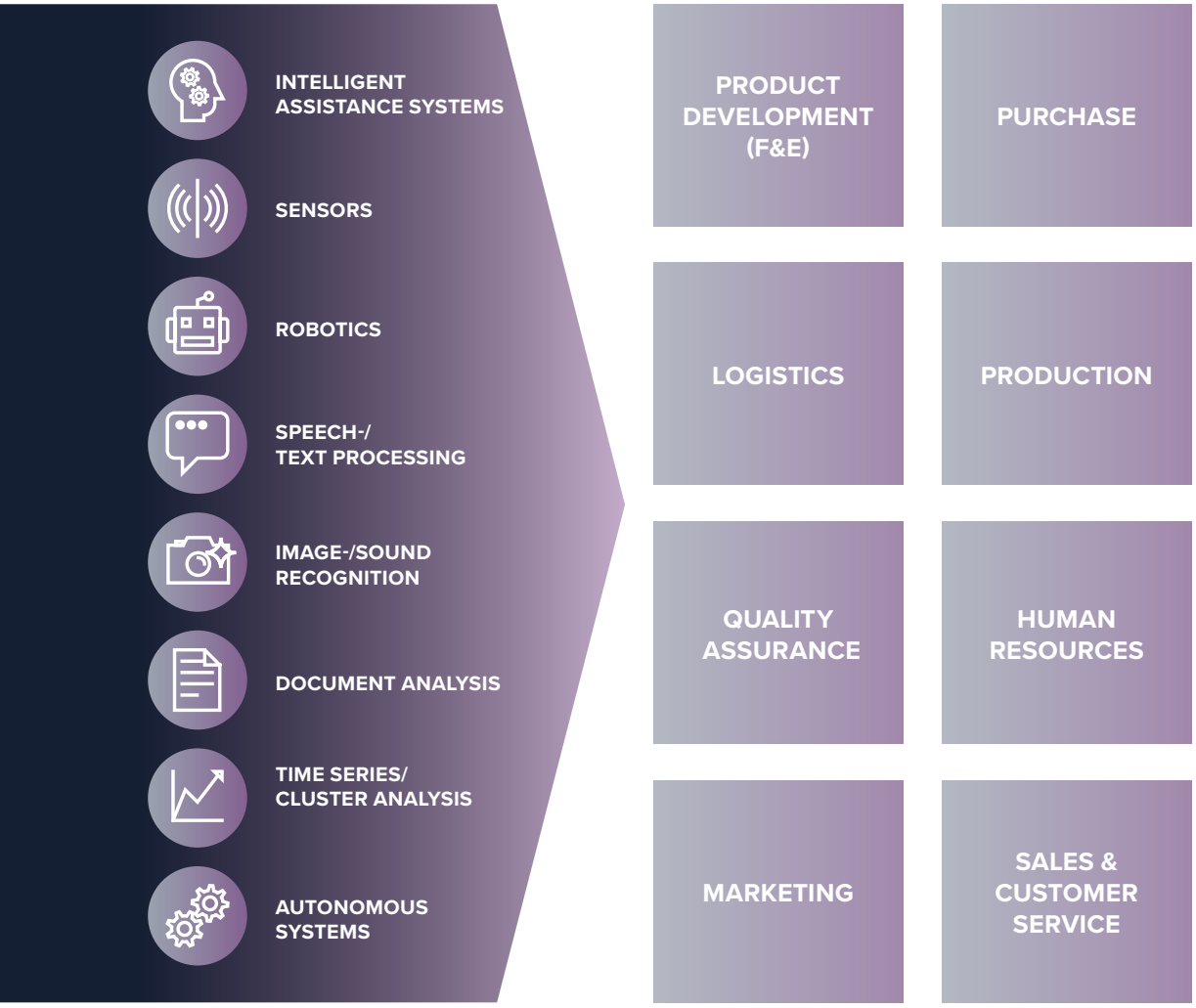
Small and medium-sized enterprises can adapt quickly to technical innovations, market potential, and changes due to short decision-making phases. Especially against this background, SMEs have a significant first-mover advantage and should react promptly.

Technology has a wide range of potential benefits and is, therefore, one of the decisive and central factors for the long-term success of SMEs. This opportunity must not be missed. But where does the implementation of AI make sense?

29 Jannis Augustin, Personal Interview on the 7th of April in 2022
30 Learning Systems – The Platform for Artificial Intelligence (2021), pp. 89

2.4 POSSIBLE USE-CASES ALONG THE VALUE CHAIN

Regarding AI technologies, there are a wide variety of possible applications for SMEs. Whether it is the quality assurance through image recognition, improving customer experience through automated product suggestions or chatbots in customer service, many application scenarios have already been realized.[31] AI technologies can create added value in almost every section of the value chain in companies.



Diverse Use-Cases for AI[32]

31 Reder (2021), p. 13
32 Own representation based on Learning Systems – The Platform for Artificial Intelligence (2021), p. 9

To identify suitable use-cases of AI technologies in one's own company, it can be helpful to take on the perspective of an employee:

> *Look for process where burn-outs and bore-outs meet among employees."*[33]
>
> – Lukas Naab, Co-Founder of MINDS Medical and Digital Health

AI can provide particularly effective support where employees are overworked. At the same time, AI can also be helpful when repetitive tasks characterize the daily work routine. Employees can be relieved of those tasks by AI, thus having more time to invest in real value-creating activities. An applied example from the field of human resources aims at the optimal placement of employees on projects according to their qualifications.

ITERATEC GMBH

In-house search for experts with a specific skillset[34]

The aim of the software solution is to identify experts quickly and easily for particular topics within the company and, thus, address them in a targeted manner. Based on Natural Language Processing, specific sources such as skillset databases, project descriptions or chats are scanned for keywords.

33 Lukas Naab, Personal Interview on the 21th of June in 2022
34 VDMA (2020), p. 22

3 CHALLENGES DURING THE IMPLEMENTATION PROCESS OF AI TECHNOLOGIES

3 CHALLENGES DURING THE IMPLEMENTATION PROCESS OF AI TECHNOLOGIES

When introducing AI, SMEs can encounter several obstacles. Due to companies' diverse models, many possible challenges impede entering the AI era.[35]

Eleven challenges were identified during the interviews as well as the literature review, which can be classified into three categories:

TECHNOLOGY, ORGANIZATION & PEOPLE.

The individual areas cannot be clearly distinguished from one another. It is worth noting that the majority of challenges can be found internally inside the company's organization.

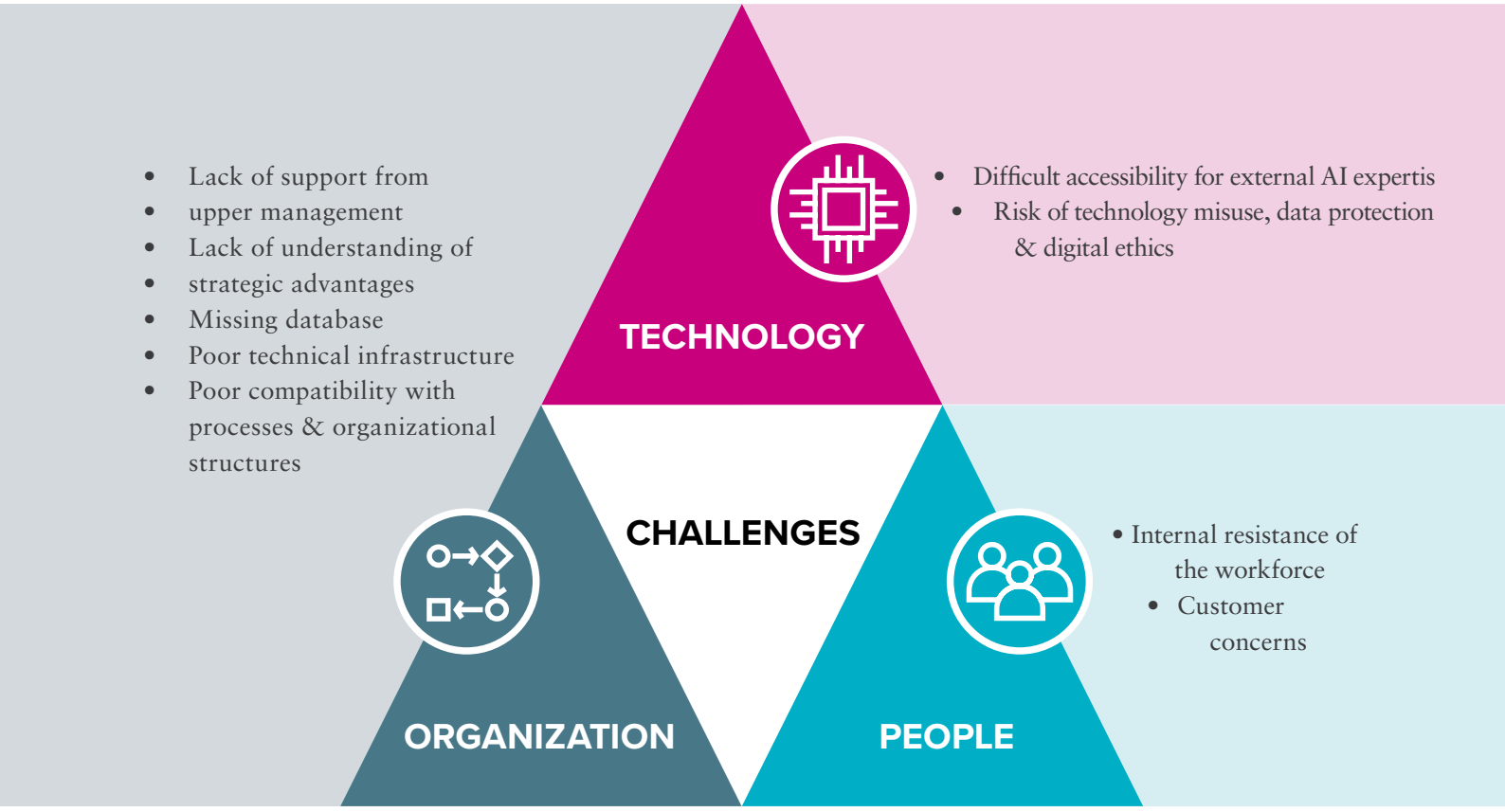


Fig. 3: Three core areas of implementation challenges for SMEs[36]

35 Learning Systems – The Platform for Artificial Intelligence (2021), p. 66
36 Own representation

3.1 TECHNOLOGY

RISK OF TECHNOLOGY MISUSE, DATA PROTECTION AND DIGITAL ETHICS

Particularly regarding AI solutions with apparent hazards, such as autonomously driving robots, the fear arises that these could fall into the wrong hands or be misused. A study conducted by Oxford University predicts the expansion of existing dangers and the emergence of new **dangers through AI**.[37] One example of such a new danger includes deep fakes, which make it possible, among other things, to manipulate the image and sound of live video transmission in such a way that someone can deceptively impersonate another person.

> *AI will be either the best, or the worst thing, ever to happen to humanity.“*
>
> – Stephen Hawking, Physicist

Beyond criminal influence, the increasing autonomy of AI-based systems raises the question of **personal or third-party responsibility.**[38] Defined **legal frameworks** are necessary to ensure the safety of all involved. The use of AI must also follow a binding framework regarding digital ethics, especially to prevent **discrimination through AI**. For example, Amazon developed a chatbot that was supposed to generate a ranking for incoming job applications to optimize the personnel selection process. One year after it went live, **the bot was found to be operating in a discriminatory manner**, ranking female applicants lower than male applicants.[39]

37 Hatiboglu et al. (2021)
38 Buchkremer et al. (2021), p. 77
39 Mülder W (2021), Sind Chatbots die besseren Recruiter?, Personal Magazine No. 6 (2021), pp. 66

Regulatory efforts are being made by the European Union: With its regulation **on artificial intelligence**[40], the European Commission is striving for uniform regulations for its member states in dealing with AI technologies. Among other things, introducing an "electronic person"[41]) alongside natural and legal persons is being debated.

In addition, case-specific issues such as data protection, including data storage, must be carefully examined on a case-by-case basis within the company.[42] Particular attention must be paid to compliance with the **General Data Protection Regulation** (**GDPR**). A review of the legal assessment is required, especially because of the increasing social significance of AI-supported processes.[43] SMEs without their own legal department, in particular, need legal certainty to be able to participate in AI technologies.

DIFFICULT ACCESSIBILITY FOR EXTERNAL AI EXPERTISE

A study by IDG Research Services states that the biggest obstacle is the lack of AI expertise. This was also addressed in various interviews with SMEs conducted as part of this paper.

Consulting firms usually have industry specialization and offer their expertise in specific areas.[44] The main focus of selecting a suitable consulting firm is finding the right "fit." Therefore, it is advisable to approach the consultants with a concrete problem and check their specializations in advance. It is advisable to begin with a **Minimum Viable Product** (**MVP**). That way, an issue of manageable scope can be focused on so that it is easy to maintain an overview and progress rapidly. Therefore, no time is lost in the conception of large project plans.[45,46]

40 European Parliament (2021), p. 1
41 Buchkremer et al. (2020), p. 5
42 Demary and Goecke (2020), p. 2
43 Hoeren and Niehoff (2018), p. 47
44 Philipp Hinz, Personal Interview on the 2nd of June in 2022
45 Philipp Hinz, Personal Interview on the 2nd of June in 2022
46 Jannis Augustin, Personal Interview on the 7th of April in 2022

3.2 ORGANIZATION

LACK OF SUPPORT FROM THE UPPER-MANAGEMENT

The organizational conditions for implementing AI in SMEs are generally good since quick decision-making means that it is often possible to react more quickly to developments in the market.[47] However, the focus on day-to-day operations is too high. The use-case potential is high, so AI should be considered as part of future enterprise plans.[48]

Precise positioning and focus on the topic at the management level are essential for its success. Success can only be achieved if the executive board and management stand behind the technology and are actively committing to it. The topic must be classified as essential and in line with corporate goals so that prioritization occurs in day-to-day business.[49, 50, 51]

LACK OF UNDERSTANDING OF STRATEGIC ADVANTAGES

The lack of support from the upper management could be the need for more understanding of the technology. After all, how can you define a vision or release investments without seeing concrete added value by AI for the company?

To ensure a better understanding and follow innovations, the use of so-called innovation scouts can be helpful.

They attend AI events, such as trade fairs, to explore new technologies and act as a type of "translator" for companies.[52] In addition, there are many seminars and info-material – for example, from the chambers of industry and commerce as well as associations such as the AI Frankfurt Rhein-Main e.V.

Fig. 4: Source Dall-E mini – Upper Management

47 Learning Systems – The Platform for Artificial Intelligence (2021), p. 8
48 Dukino et al. (2020), p. 62
49 Jannis Augustin, Personal Interview on the 7th of April in 2022
50 Learning Systems – The Platform for Artificial Intelligence (2021), p. 68
51 Learning Systems – The Platform for Artificial Intelligence (2021), pp. 74
52 Learning Systems – The Platform for Artificial Intelligence (2021), p. 74

LACK OF FINANCIAL RESOURCES

According to a study by IDG Research Services, only 41% of the surveyed companies with an IT budget of less than 10 million Euros use machine learning, a fundamental component of AI technology. On the other hand, companies implementing machine learning with a higher budget make up 62%.[53] The available budget can, therefore, be a reason for postponing or failing to introduce an AI solution, particularly for small enterprises.[54]

Compared to traditional investments, such as the purchase of machinery, **productivity gains do not necessarily become apparent immediately after the implementation.** This can make it very difficult to calculate the benefits of an AI investment.[55, 56] In addition, it is often difficult to calculate a return on investments (ROI) because improvements, such as on-time delivery to customers, are difficult to measure.[57] The company must be aware of this and try to analyse the to-be-improved processes in monetary terms to make better comparisons.[58]

Another option is to introduce **AI-as-service**. AI-as-service solutions are based on the principle that the software and the IT infrastructure are operated by an external IT service provider and used by the customer as a service, which usually involves lower investments. In addition, less know-how is required within the company, and a faster start is possible, which can shorten the time-to-value ratio.

MVTEC SOFTWARE GMBH

Quality inspection in the food industry

An AI with object detection was introduced to ensure uniform standards such as size and degree of browning in bakery production. However, quality inspection of handmade products with variable sizes, shapes, and structure is challenging. The detected objects are measured and classified according to the degree of browning and uniformity of ingredients based on empirical values.[59]

53 Reder (2021), p. 11
54 Friedrich et al. (2021), p. 142
55 Learning Systems – The Platform for Artificial Intelligence (2021), p. 68
56 Mittelstand Digital (2020b), p. 17
57 Björn Heinen, Personal Interview on the 14th of April in 2022
58 Accompanying Research for Mittelstand Digital, p. 8
59 VDMA (2020), p. 18

LIMITED INTERNAL HUMAN RESOURCES

Another major challenge is the need for more internal personnel skills and resources. New positions must be created and filled purely for the internal implementation of AI projects. This is challenging for SMEs since **skilled personnel is rare** in the labour market, and the budget is strictly limited.[60, 61, 62] As a result, SMEs are rarely able to prevail against large companies in the competition for IT experts.[63, 64]

In general, the necessary expertise can also be obtained externally. The importance of **AI service providers and consultants will continue to increase in the future.**[65] Nonetheless, cooperation with external providers needs just as much support from the **departments** to achieve substantial progress in using AI technologies. This requires a **basic understanding of the opportunities and limitations of using AI technologies** to assess the concrete application possibilities and technological requirements. Therefore, employee **information and training opportunities** must be created and, ideally, continuously developed.[66]

Since AI solutions with a certain degree of complexity lead to long-term process changes, it is essential to adequately consider personnel capacities for the time after implementation.[67]

MISSING DATABASES

The availability of digital data forms the **basis for** introducing AI applications. Only with the help of this data can **adaptive systems** be trained. Unfortunately, these data are the cause of great concern for most companies.[68, 69]

In the end, machine data must be collected. That is why, in the following example, process data from the production is collected by means of sensors. Maintaining a comprehensive overview of the volume of data produced can be challenging. Networking of the individual systems must be ensured so that **data can be continuously collected and processed**. The goal, therefore, is to turn many "data puddles" into lakes.[70, 71]

60 Haiber et al (2022), p. 41
61 Jannis Augustin, Personal Interview on the 7th of April in 2022
62 Philipp Hinz, Personal Interview on the 2nd of June in 2022
63 Learning Systems – The Platform for Artificial Intelligence (2021), p. 68
64 Jannis Augustin, Personal Interview on the 7th of April in 2022
65 Reder (2021), p. 7
66 Learning Systems – The Platform for Artificial Intelligence (2021), p. 69
67 Learning Systems – The Platform for Artificial Intelligence (2021), pp. 68
68 Learning Systems – The Platform for Artificial Intelligence (2021), p. 66
69 Jannis Augustin, Personal Interview on the 7th of April in 2022
70 Friedrich et al. (2022), p. 140
71 Mittelstand Digital (2020b), p. 21

PLASTIKPACK GMBH

Process monitoring in the production of plastic canisters

The Plastikpack GmbH manufactures hazardous-goods-canisters. To meet the high-quality standards, the processes must be stable and robust. However, production defects were usually collected after production in the quality control process. This resulted in high follow-up costs due to rejects.

The company, therefore, opted for process monitoring using AI. Process parameters, especially sensors such as pressure and temperature, are monitored. Deviations are reported immediately and documented with piece-by-piece accuracy. This way, it is possible to intervene at an early stage and minimize defects. Any deviations are reported to the system so the AI system continuously learns.[72]

The **digitalization of processes** is, therefore, a fundamental prerequisite for the introduction of AI. But despite intensive digitalization efforts, companies still have deficits compared to digital pioneers, according to a survey conducted by the Chamber of Industry and Commerce. On a school grade scale, companies rated themselves as satisfactory in 2022, unchanged from the previous year. This means the great leap forward in digitalization still needs to be found.[73] So far, only some SMEs have fully digitized their processes and production; many are just starting to do so. For example, production lines still need to be fully equipped with sensors, which is why less data is collected.[74]

This digitalization process is highly dependent on the actual business of the company and its business model. It makes a difference, for example, whether companies are active in the service sector or production. There are also differences depending on the size and industry of the company. The quality of the available data should not be neglected. Particularly in the case of small companies, the incompleteness and inaccuracy of the data can be a problem.[75]

Incomplete and unstructured data can hinder the introduction of AI systems, making it very difficult to adequately train the algorithms underlying AI technologies.[76] It is, therefore, recommended to start with a relatively small area to have sufficient numbers, data quality, and a good overview.

72 Mittelstand Digital (2020b), p. 19
73 German Commercial and Industrial Chamber, p. 5
74 Learning Systems – The Platform for Artificial Intelligence (2021), pp. 7
75 Learning Systems – The Platform for Artificial Intelligence (2021), p. 8+66
76 Friedrich et al. (2022), p. 140

INADEQUATE TECHNICAL INFRASTRUCTURE

Poor technical infrastructure poses the next challenge. These challenges already begin with a bad internet connection; SMEs, specifically in rural areas, are affected.[77]

Furthermore, functional data infrastructure is an essential prerequisite, which should essentially contain IT systems for the following elements

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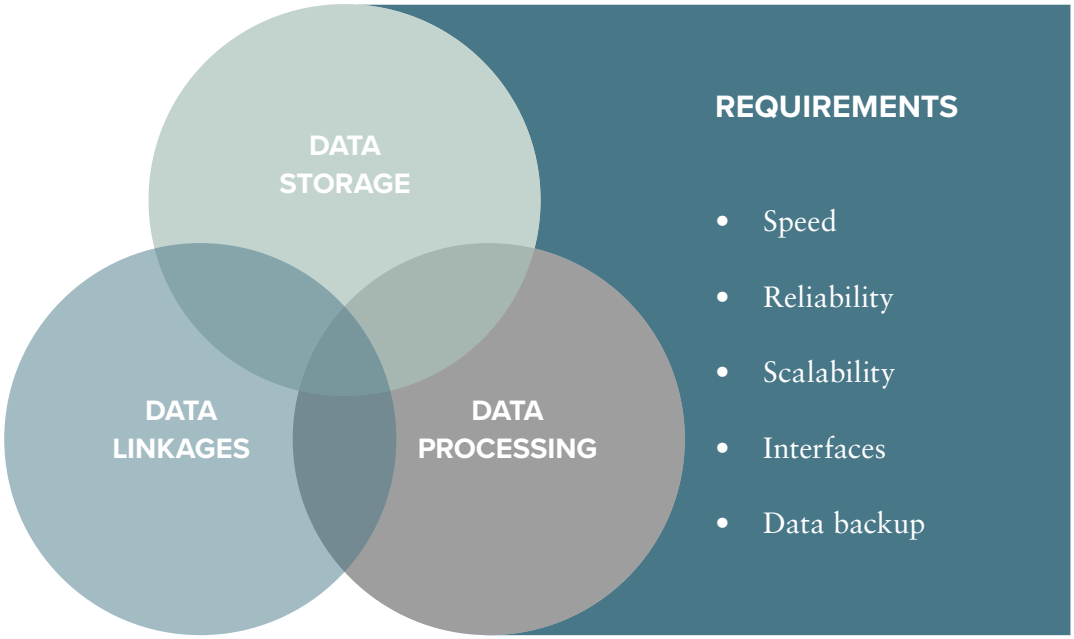


Fig. 5: Requirements for an IT Infrastructure[78]

The IT infrastructure should enable the individual system to be linked so that data can be **stored** in a **structured manner** and **read out** easily.[79] It is important to prevent multiple parallel running systems, as it makes management and operation more difficult. Outdated systems that do not always allow for data to be exported, or necessary reports to be generated, can be a bottleneck for further growth. [80]

77 Friedrich et al. (2022), pp. 140
78 Own representation based on Learning Systems – The Platform for Artificial Intelligence (2021), p. 66
79 Mittelstand Digital (2020b), p. 21
80 Mittelstand Digital (2020b), p. 21

In the best case, a new AI solution is built on existing programs to avoid additional expenses, such as the implementation of new systems or the need for further employee training.[81] If possible, it is recommended to re-fit existing machines and equipment, as shown in the example below. This is known as retrofitting. This can often be a suitable alternative to a new acquisition because an increase in performance can be achieved at a low cost and in a shorter time.[82]

KIEFEL GMBH

Intelligent sensor for identifying defective foils in packaging production

When processing plastics, loading the machine with faulty foils can lead to extensive production losses. Therefore, incorporating the quality control of the foils by a sensor integrated into the line is a provided remedy. An AI application analyses and evaluates fuel parameters such as material type and thickness in real-time.[83]

LACKING COMPATIBILITY WITH PROCESSES AND ORGANIZATIONAL STRUCTURES

Implementation alone is not enough to use AI systems in a value-adding way. The introduction always entails innovations, so **processes must be adapted and organizational structures reconsidered.**[84]

81 Areback and Rönnberg (2020), p. 8
82 https://digitalzentrum-hannover.de/ki-nutzung-beim-retrofit/, retrieved on the 18th of July in 2022
83 VDMA (2020), p. 17
84 Learning Systems – The Platform for Artificial Intelligence (2021), p. 68

ELSINGHORST STAHL UND TECHNIK GMBH

Intelligent receival of goods in logistics for faster processing of time sensitive orders

Until now, the incoming goods department of the steel and engineering distributor was not automated. This meant urgent deliveries had to be identified manually, which was time-consuming.

With the help of an AI solution, delivery bills of incoming parcels are now automatically checked for urgency by text recognition. A link to the ERP system automatically updates the status of incoming parcels. This allows the responsible departments to more quickly oversee the status of a shipment and pass it on to the customer. [85]

In this example, the **effects on internal processes and responsibilities** are visible: The previously time-consuming, manual working process of the employees receiving the goods has changed. These changes in process and roles must be **documented and trained** so that it becomes a **new work routine** .[86] The change in activities usually results in a need for new roles and competencies.[87]

Another key question arises: What external or internal competencies exist for the AI application?[88, 89] The interviewees advise the following: It is essential to have sufficient internal resources to manage the AI solution on an ongoing basis after the implementation. In combination with internal resources, a consulting team can be helpful in the planning and implementation of AI. With a basic internal understanding, selected employees can act as mediators or "**translators**" between the business department and the technical teamn.[90] Depending on the scope of the AI project, it may also make sense to establish a dedicated team known as a Centre of Excellence.[91, 92]

It is particularly important to emphasise that the workforce is at the centre of any change inside the company and that dealing with any resistance is a critical success factor for implementing AI solutions.

85 Mittelstand Digital (2020a), p. 26
86 Mittelstand Digital (2020a), p. 26
87 Dukino et al. (2020), p. 36
88 Philipp Hinz, Personal Interview on the 2nd of June in 2022
89 Jannis Augustin, Personal Interview on the 7th of April in 2022
90 Philipp Hinz, Personal Interview on the 2nd of June in 2022
91 Philipp Hinz, Personal Interview on the 2nd of June in 2022
92 Jannis Augustin, Personal Interview on the 7th of April in 2022

3.3 PEOPLE

INTERNAL RESISTANCE OF THE WORKFORCE

As was already made clear in the previous chapter, **the human factor** cannot be neglected in the implementation of AI. According to a study, 32% of companies see a resistance of acceptance by employees as one of the most critical factors.[93] Employees often lack the necessary understanding of and trust in AI, which is why **covert and overt resistance** is to be expected.[94]

Frequent causes are fears about the **individual effects** on the personal workplace. This can lead to the perception that one's **freedom of decision** is being undermined and that employees' responsibility is being diminished.[95] Furthermore, the increasing autonomy of AI-based systems often raises concerns about **the loss of control over technology.**[96]

But how do you deal with such resistance? The answer is structured change management, with **intensive communication and employee involvement.**[97] First of all, an understanding of the possibilities and functionality of AI must be created.[98] Risks should be openly discussed, and training opportunities made available.[99] Additionally, early involvement of the process participants and later users is essential, even during the development phase. Employees should understand that they are helping to reshape their workplace and can be effectively relieved from time-consuming routine tasks through AI technologies.[100, 101] Furthermore, the fears and concerns of employees must be given space; therefore, managers play a key role in supporting the AI transformation process.[102]

CARPENTRY KASPER

Knowledge transfer and further training of employees[103]

The resignation of some employees at Kasper is a cause for concern for the company. To pass on the knowledge of experienced colleagues, the practical work-processes are to be filmed. With the help of AI, the recorded sequences are to be indexed, thus simplifying the search. With the help of this application, relatively inexperienced employees can find the respective work processes and the video sequence via a keyword search.

93 Reder (2021), p. 27
94 Reder (2021), p. 27
95 Friedrich et al. (2022), p. 147
96 Buchkremer et al. (2020), p. 77
97 Friedrich et al. (2022), p. 147
98 Haiber et al. (2022), p. 42
99 Learning Systems – The Platform for Artificial Intelligence (2021), p. 70
100 Learning Systems – The Platform for Artificial Intelligence (2021), pp. 69
101 Learning Systems – The Platform for Artificial Intelligence (2021), p. 8
102 Stowasser and Neuburger (2022), p. 3
103 Mittelstand Digital (2020b), p. 13

CUSTOMER CONCERNS

According to one study, 24% of companies see a negative attitude on the part of customers as a potential problem.[104] It is interesting to note that, according to research, AI services such as the automated issuing of visas or the payment of social benefits are accepted. However, there is little trust in the automated granting of loans or AI-based medical diagnoses.[105] Uncertainty and lack of knowledge on the part of customers thus pose **the risk of a lack of acceptance and trust** in products, services and processes modified by AI.[106]

Customer proximity during the entire implementation process is, therefore, necessary for successful implementation. In this respect, SMEs have an advantage over large companies because their structures and processes are more transparent, and customer relationships are usually more intensive.[107] For example, it can make sense to provide accompanying materials and address concerns directly in exchange with the customer, especially in the B2B sector.

104 Reder (2021), p. 27
105 Reder (2021), p. 3
106 Friedrich et al. (2022), p. 141
107 Haarmeier (2021), p. 41

4 GUIDANCE FOR SMES

4 GUIDANCE FOR SMES

> *All difficulties and obstacles are steps on which we ascend."*
>
> – Friedrich Nietzsche

4.1 RECOMMENDATIONS FOR CHALLENGING OBSTACLES

So far, it has become clear that AI offers numerous potential benefits for SMEs, which should be used in a targeted manner. On the other hand, challenges need to be overcome. How can these challenges be resolved on the way to implementing such technology?

4 GUIDANCE FOR SMES

The following overview offers guidance and recommendations to overcoming challenges:

TECHNOLOGY

PEOPLE

ORGANIZATION

DIFFICULT ACCESSIBILITY FOR EXTERNAL AI EXPERTISE

Start small. Formulate your project as precisely as possible to give consultants a good insight into your project plan. This will help you to avoid over-dimensioned offers.

RISK OF TECHNOLOGY MISUSE, DATA PROTECTION & DIGITAL ETHICS

Integrate data protection officers into your project from the start to identify and eliminate any challenges as early as possible.

CUSTOMER CONCERNS

Inform your customers in good time about the upcoming change and maintain customer proximity during the implementation process. Make it clear to your customers what advantages the changes will bring. This way, fears can be identified and addressed at an early stage.

INTERNAL RESISTANCE OF THE WORKFORCE

Make it clear to your employees that introducing AI will enable them to return to value-creating tasks. They will have more time for the work and projects that matter.

LACK OF SUPPORT FROM THE UPPER-MANAGEMENT

Use practical examples to ensure that the upper management sees AI's relevance and added value. This is the only way to prioritize the topic properly.

LACK OF COMPATIBILITY WITH PROCESSES AND ORGANIZATIONAL STRUCTURES

Keep in mind that the introduction of AI brings innovations to the process. Therefore, ensure good documentation and training for the specific department. In addition, organizational adjustments must be considered in the event of changes regarding responsibilities.

LACK OF UNDERSTANDING OF STRATEGIC ADVANTAGES

Contact so-called "innovation scouts" or experts. They will help clarify and identify the added value as well as an understanding of AI within the company.

MISSING DATA BASIS

Start with a relatively small area to have the digital data available in sufficient quantity and quality while keeping an overview. Once you have gained experience here,it will be easier for you to implement it in other areas.

LIMITED HUMAN RESOURCES

Look for employees who can act as an intermediary between technology and business with a basic understanding of AI. Provide information and training opportunities.

LACK OF FINANCIAL RESOURCES

The actual added value of AI is difficult to quantify in monetary terms. Be aware of this and try to analyse the processes to be improved in monetary terms to formulate a better comparison.

INADEQUATE TECHNICAL INFRASTRUCTURE

Make sure that your technical infrastructure is fast, reliable, and scalable. Data must be stored securely; interfaces must be identified. Take a long-term, strategic view to avoid parallel or obsolete systems.

Fig. 6: Overview of the core challenges for AI implementation and recommendations for action.

4.2 ROAD MAP TO AI IMPLEMENTATION

There is no optimal universal roadmap for implementing AI in SMEs. However, it is recommended that the following steps be acknowledged during the planning phase. These six steps provide a content-related and chronological orientation for a successful introduction to AI:

RECOMMENDATIONS FOR ACTION – *From the idea to the implementation*

Fig. 7: Steps of a successful AI Implementation[108]

1. ACQUIRING A BASIC UNDERSTANDING OF AI AS A PREREQUISITE FOR SUCCESS

Basic internal knowledge of AI makes it easier to convince stakeholders of the importance of the technology. In addition, this is the only way to identify meaningful use-cases and clearly define requirements for a solution. On this basis, selecting a suitable service is also easier later on.

Under no circumstances should AI be introduced at any price. It should always be examined in a problem-oriented manner whether the desired effect can already be achieved through classic process improvement.[109]

2. BUILD A TEAM AND/OR HIRE CONSULTANTS

After management decides to introduce an AI solution, **various supporting partners** must be brought into the project. Selecting internal team members is easier if corresponding colleagues have AI knowledge. These employees can act as **intermediaries** between the specific department and the technical team.[110] Depending on the scope of the AI project, it may also make sense to set up a separate team known as the Centre of Excellence.[111, 112]

108 Own representation
109 Dukino et al. (2020), p. 4
110 Philipp Hinz, Personal Interview on the 2nd of June in 2022
111 Philipp Hinz, Personal Interview on the 2nd of June in 2022
112 Jannis Augustin, Personal Interview on the 7th of April in 2022

However, if SMEs do not have or cannot establish the expertise in-house, they **should work hand in hand with external consulting firms**. Before making an inquiry, it is important to check the specializations of the consulting firm in advance and **to know exactly what one's needs are**. The more precisely the need is known, the better consultants can provide concrete support to companies.[113, 114]

3. CREATE CLEAR OBJECTIVES, FEASIBILITY & POTENTIAL ANALYSIS

The company's lack of **clear strategic orientation towards data-driven acting** makes implementing AI initiatives significantly more difficult.[115] SMEs must first identify which use-cases represent added value to the company. Here, it is important to focus as quickly as possible on **concrete scenarios and use-cases** of highly competitive relevance.[116]

The second step would be to evaluate potential AI application scenarios regarding **feasibility and its potential.**

4. TAKING EMPLOYEES' CONCERNS SERIOUSLY, CLARIFYING THEM AND TURNING THOSE INFLICTED INTO PARTICIPANTS

Open and early communication within the company about the opportunities and risks of introducing AI creates a basic understanding among the workforce. It enables the concerns of the workforce to be addressed proactively. **Transparency about goals and ongoing activities** must also be established. Employees are supported by a clear picture of goals – where, how, and why they should use the AI applications.[117] The qualification of capable employees for identifying the AI's potential and developing use-cases creates additional confidence.

5. CREATING NECESSARY DATA INFRASTRUCTURE INSIDE THE COMPANY

Data availability and data quality form the fundamental basis for all AI systems in order to be able to extract information from it.[118] SMEs should improve **data collection, use and analysis** for relevant business areas, and expand them as necessary.[119]

In addition, **data from different sources** are often used in an AI project. It must be ensured that this data can be traced and applied. It must be checked whether data has been released for everyday use and whether the use of personal data means that the GDPR applies.[120]

113 Jannis Augustin, Personal Interview on the 7th of April in 2022
114 Philipp Hinz, Personal Interview on the 2nd of June in 2022
115 Friedrich et al. (2022), p. 144
116 Haarmeier (2021), p. 43
117 Dukino et al. (2020), p. 63
118 VDMA (2020), p. 33
119 Dukino et al. (2020), p. 63
120 VDMA (2020), p. 34

> *Bad analogue processes lead to bad digitized processes and bad digitized processes lead to bad data input for AI“* – Dr. Andreas Bildstein

The more complex the relationships are, **the more data points** are usually required. Care must be taken to attentively check data for quality and rework accordingly. This can be costly, but it ensures that the AI receives correct data. Unfortunately, checking whether the quantity and quality of data are sufficient for the AI system is often only possible during implementation, so starting on a small scale is advisable.[121]

6. IMPLEMENT AND SCALE AI

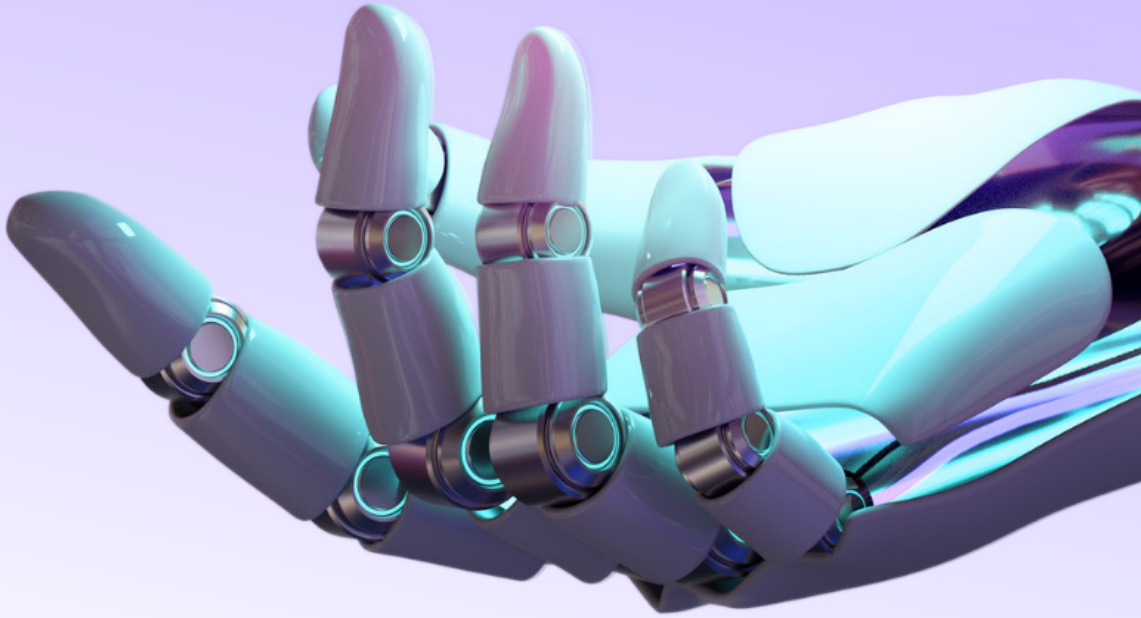
Experts advise taking the next step: **“Just start and do not give up quickly.”**[122] Our interviewees advise working with a **Minimum Viable Product** (**MVP**) or a similar approach. A project with a manageable scope can quickly provide real feedback.[123]

If external experts are used, care should be taken in this phase to ensure there is an appropriate **knowledge transfer to the company itself**. **Cross-company networking**, for example, in associations, can also be beneficial for implementing AI initiatives.

It can be seen that digital transformation measures on the way to AI can already contribute to saving operation resources in the short term.[124] SMEs, in particular, face tremendous competitive pressure in personnel acquisition. AI solutions offer effective leverage in the medium term to counter demographic trends.

121 VDMA (2020), p. 34
122 Dukino et al. (2020), p. 64
123 Dukino et al. (2020), p. 64
124 Friedrich et al. (2020), p. 150

5 SUMMARY AND CONCLUSION



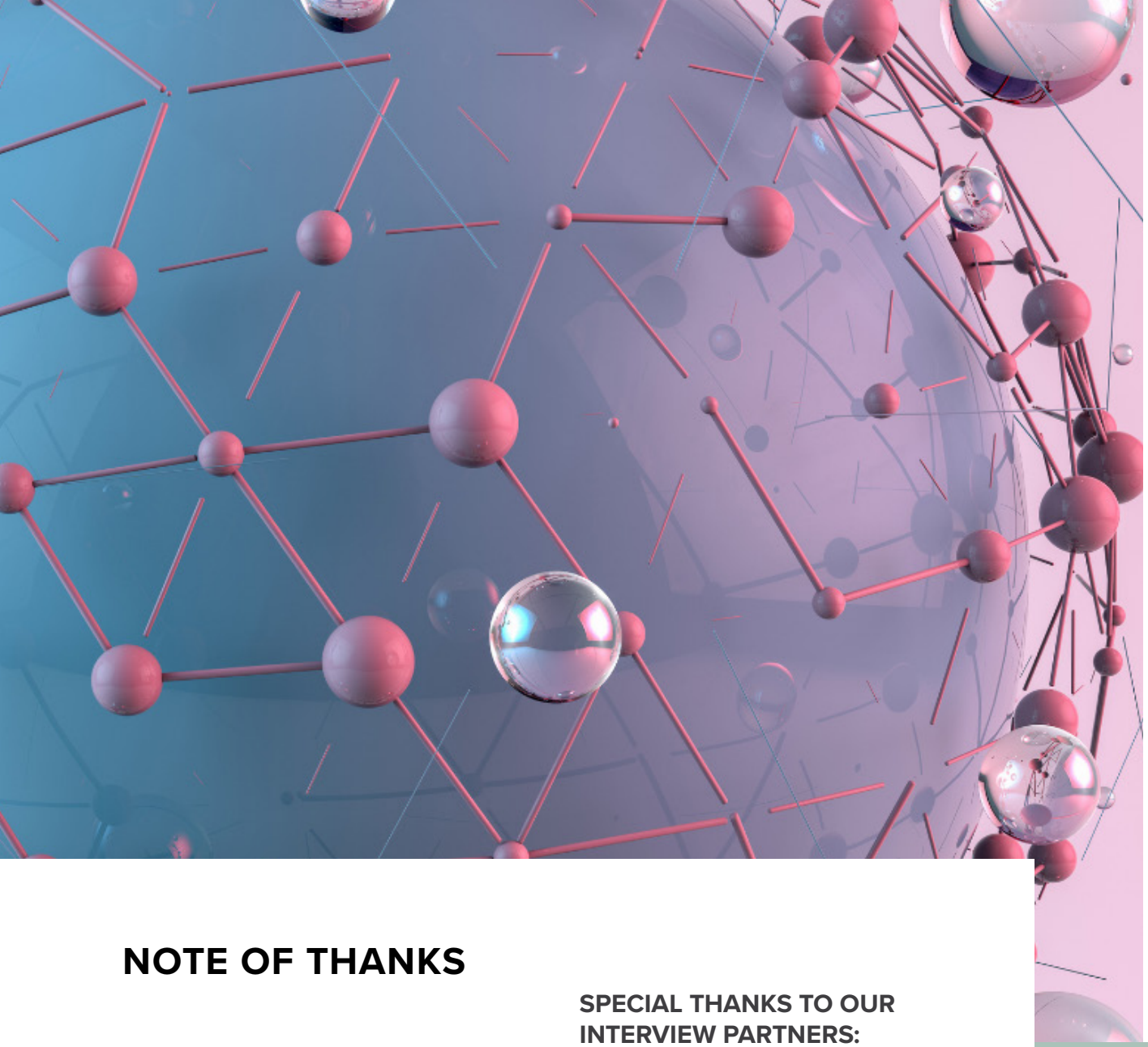
AI offers potential across various industries along the entire value chain. These include quality insurance, increased productivity and efficiency, and customer relations. Technology will play an increasing role in almost all industries and has long ceased to be a trend. It is becoming increasingly important in ensuring future competitiveness, especially for SMEs.

More than 99% of German companies are SMEs and generate around one-third of the total turnover of companies in Germany. SMEs are, therefore, a crucial part of the German economy. Small and medium-sized enterprises, in particular, can react quickly to technical innovations, market potentials and market changes due to quick decision-making phases. In doing so, they face various challenges that must be overcome. However, many SMEs are not yet able to do this.

This paper identified key challenges for SMEs in the areas of technology, organization and people. Among the most important challenges is the problematic accessibility of external AI expertise, the missing data basis and technical infrastructure, and the internal resistance from the workforce. Despite the many difficulties, the journey is worthwhile.

SMEs should examine which specific problems can be solved using AI. After all, to be successful, you need a basic understanding of the technology, an AI strategy that fits the company, and a team that can implement it. After, it it then a matter of putting the chosen path into practice, i.e., starting with a small AI use case, gathering experience with it, and using this knowledge to expand the application in a value-adding way.

This paper presents a snapshot of the current potentials as well as the challenges and how to deal with them in relation to AI. AI is a rapidly developing, disruptive technology. It is an increasingly fast-moving train that is worth jumping on. Therefore, SMEs should follow future developments closely and use them for their benefit.



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Four years later, we have initiated another exciting stage on the way to becoming a pioneer and market leader in adult education. Together with EMS, we act as a joint brand: CBS International Business School. CBS and EUFH Management became one. With a vision for future-oriented study formats and subject areas, we merged with the management area of our Klett sister, the European University of Applied Sciences, at the beginning of 2022. This will create a strong business school with a regional and international orientation and anchoring. We, the CBS International Business School, had the opportunity to include the dual study form in our portfolio in addition to full-time and part-time study forms to gain new locations and double our number of students.

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Our mission since 2017 has been to achieve the best possible results for our renowned clients from all over Europe. We rely primarily on over 20 outstanding project teams with consultants who all have several years of professional and consulting experience to achieve this.

For our customers, we are involved as consultants, coaches and strategic partners from the initial idea of “using AI” to scaling AI applications. In addition, we participate in innovative AI startups and support their successful growth.

One focus of our consulting services is the development of intelligent automation solutions for complete business processes. In doing so, we deliberately refrain from using technology as a mere and in itself – our focus lies on realizing real value for our customers.

We see ourselves as a link between customer business requirements, solution providers and AI technologies. Therefore, we participate in regional and national AI networks to further advance Germany as an AI location.

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