

# Digital Technology Use among Small and Medium Sized Enterprises

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## Abstract

**Background:** The dynamic development of digital technologies has caused major changes in almost all areas. Small and medium-sized enterprises (SMEs) are the basis of the German economy. Adapting this group to the ongoing and ever faster economic changes is of key importance for successful continued existence of Germany as a business location.

**Objective:** The results offer crucial insights into the current implementation status of digital technologies, suggesting potential targets for supporting actions by regional initiatives and officials.

**Methods:** A web-based online survey was conducted in the northern Rhineland-Palatinate. The survey was developed and distributed to assess the prominence and distribution of digital technologies among SME.

**Results:** Basic digital technologies are the common run for SMEs. Few pioneers fall back on innovative technologies, while the majority is not aware of many important digital technologies. When it comes to implementation, manufacturing companies mainly concentrate on production-related areas. SME that rely on a digital strategy use a broader variety of digital technologies. The implementation gap is confirmed.

**Conclusion:** The current digitalisation gap in German SMEs cannot resolve on its own. An external impulse is necessary helping SMEs to address the still existing information gap, resulting in a lack of implementation. In many cases, isolated technological solutions are created that serve to solve specific problems. In particular, external support must promote a holistic view of digitization.

## Keywords

Digitalization, Industrie 4.0, Small and Medium Sized Enterprises

## 1. Introduction

The market for information technologies is constantly evolving and is leading to disruptive, digital technologies such as 3D printing, cloud computing and Blockchain that are also forcing well-established companies to change, in order to remain competitive (Lucas, et al. 2013, Yoo, et al. 2012, Nambisan, et al. 2017 ). Digital transformation refers to the organizational transformation process of using and combining digital technologies in a new way unlocking the potential to radically change enterprises and even industries (Soto Setzke, et al. 2021). However, digital technologies play a minor role for many SMEs. The enormous speed as well as high economic expectations of the digital transformation therefore give cause for concern that many established SME in Germany in particular will not be able to tap market potential and will be squeezed out of their market position in the international context in the long term. Therefore, this paper examines the prevalence of digital technologies and highlighting its drivers in order to derive insights into reducing the digitization gap in SMEs.

## 2. Literature Review

SMEs are the backbone of all developed economies across the globe, but in Germany, the use of the term Mittelstand has turned them into the core of the German business model (Reinemann 2019). Therefore, the digital

transformation of these companies is of outstanding importance for the further economic growth of Germany. However, empirical studies internationally (OECD 2021), but also in Germany (Zimmermann 2018, KfW 2022) show a pronounced digitization gap in SMEs. But this does not imply that SMEs are incapable of achieving a high level of digital maturity. On the contrary, it can be shown that highly digitized companies exist in different industries and sizes (Pröger und Runst 2019).

To explain the gap between SME and large corporations, a number of studies have been conducted that have already identified key influencing factors. Various categorizations have been developed to structure the challenges SMEs face. Orzes et al. (2019), for example, find 37 SME-specific barriers, which they group into six categories. Repeatedly, however, at least three categories are found, which are essentially related to various limitations in company resources that can be explained by a small company size.

First of all, the introduction of digital technologies involves considerable financial investment, which SMEs are rarely able to raise due to poorer access to capital markets (Rao et al. 2021). This is particularly supported by the unknown costs and payback time of digitization projects (Heilala et al. 2020). The first step into digital transformation is hampered by the fact that these projects are associated with very high initial costs in terms of acquiring the knowledge to apply digital technologies, but ever decreasing marginal costs of realizing efficiency gains in additional intra-firm domains (Proeger and Runst, 2019).

Second, there is a limitation in the perception of digital technologies in SMEs. There is no understanding of the opportunities that digital technologies could bring to business (Heilala et al. 2020, MacFarlane et al. 2022). Especially family managed SMEs act in a risk-averse manner and forego growth opportunities (Gomez-Mejia et al. 2007) as well as innovation activities (Hoffmann et al. 2019). It could be shown that formal education and the age of the owner-manager have a significant influence on digitization projects in SMEs (Zimmermann 2019). In this context, it is also noteworthy to consider time constraints that do not allow SMEs to acquire the information on digital technologies in their daily business (Masood and Sonntag 2020).

Third, the availability of skills in the workforce has a significant impact on the digitization of SMEs. Studies have found a relationship between digitization activities and the presence of academically qualified employees (Zimmermann 2019).

### **3. Methods**

A web-based online survey was conducted between 3rd November and 3<sup>rd</sup> December 2021 to determine the prevalence of digital technologies in northern Rhineland-Palatinate. This research method allows for an easy and quick participation of a large target group (Israel 2011). In addition, built-in features for data cleaning and a wide range of design tools improve respondents' survey-experience (Monroe und Admans 2012). However, low response rates are a well-known drawback of web-based surveys (Rice, et al. 2017). Thus, it is crucial to take measures to boost response rate (Monroe und Admans 2012, Nulty 2008):

- 1) Regional business development councils that maintain close contact with local SME distributed the survey.
- 2) SME were contacted with personalized serial emails giving a brief introduction into the research topic.
- 3) The survey was kept brief and potential participants were informed about the approximately time of completion, beforehand.
- 4) To avoid concerns anonymity of responses was assured.
- 5) A short pre-briefing underlines the professionalism and persuades respondents that their participation is of high value.

According to Ballantyne (2003) these measures are additive in their effect.

The survey was developed based on a preliminary expert study and the results from a literature review. Considered technologies are also based on these results and were compared to the technology radar of the Saarbrücken Competence Center (MDZ Saarbrücken 2022). Overall, 26 digital technologies were divided into three groups: administration, production and cross-departmental. Subjects evaluated the current deployment status for each technology, also giving insights in irrelevant or unknown technologies for the company. Further, the survey included

categorical questions related to the status quo of digitalisation and its drivers. Corresponding questions split the sample and limited participation to SME decision-makers of the northern Rhineland-Palatinate. The evaluation is purely descriptive.

## 4. Results

### 4.1 Survey respondents

As indicated in Table I, 128 SME representatives met the conditions of participation and fully completed the survey. This results in an overall response rate of 15.4 per cent, with a completion rate of 68.3 per cent.

75.7 per cent of subjects were executive directors of SMEs. Another 17.1 per cent accompany the role of the head of department. 4 digitalization officers took part, equally divided between small (10-49) and large (>250) companies. Micro (25.0%), small (32.8%) and medium-sized (28.1%) companies took part in the survey to a similar extent. Large companies, that employ 250 to 500 people, were less represented with a share of 14 per cent.

A distinction was made between four sectors. Most belong to service industry (32.8%) or manufacturing industry (41.4%).

**Table I Demographics (n=128)**

<b>Variabel</b>		<b>n (%)</b>
Economic sector	Manufacturing industry	53 (41.4)
	Service industry	42 (32.8)
	Primary production	6 (4.7)
	Wholesale	11 (8.6)
	Other	16 (12.5)
Headcount	0-9	32 (25.0)
	10-49	42 (32.8)
	50-250	36 (28.1)
	>250	18 (14.1)
Position	Executive director	97 (75.7)
	Head of department	22 (17.1)
	Team Manager	1 (0.7)
	Digitalization officer	4 (2.8)
	Other	4 (2.8)

### 4.2 Status quo of digitalisation

Compared to their competitors, the majority of the companies surveyed rate themselves in a somewhat advanced position in terms of digitalisation. Overall, 44.5 per cent of subjects said they were somewhat progressive. A further 10.2 percent see themselves as pioneers in their industry, whereas only every eighth subject considers its company to be somewhat unprogressive. A single respondent sees his own company left far behind in the field of digitalisation. One out of three see their company on a comparable level to their competitors. Broken down by company size, it is can be seen that in particular microenterprises (15.6 %) and medium-sized companies (16.6 %) see themselves at the top of their industry. Bigger companies rate themselves in a somewhat advanced position, with none of them left behind. In contrast one out of four small-enterprises, see a clear call for action compared to their competitors.

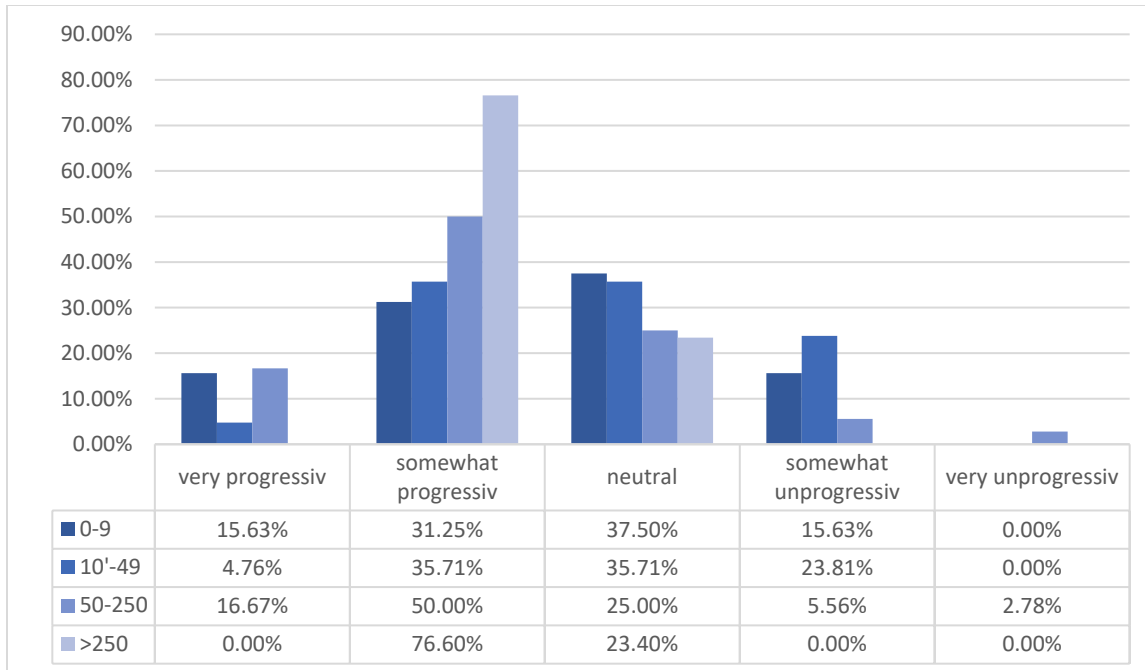


Figure 1. Progress in the use of digital technologies compared to competitors by headcount (in per cent, n=128; n(0-9)=32; n(10-49)=42; n(50-250)=36; n(>250)=18)

Every second company has clearly delegated responsibility for digitalisation. 57 percent stated that a clear digital strategy exists. Four percent were undecided.

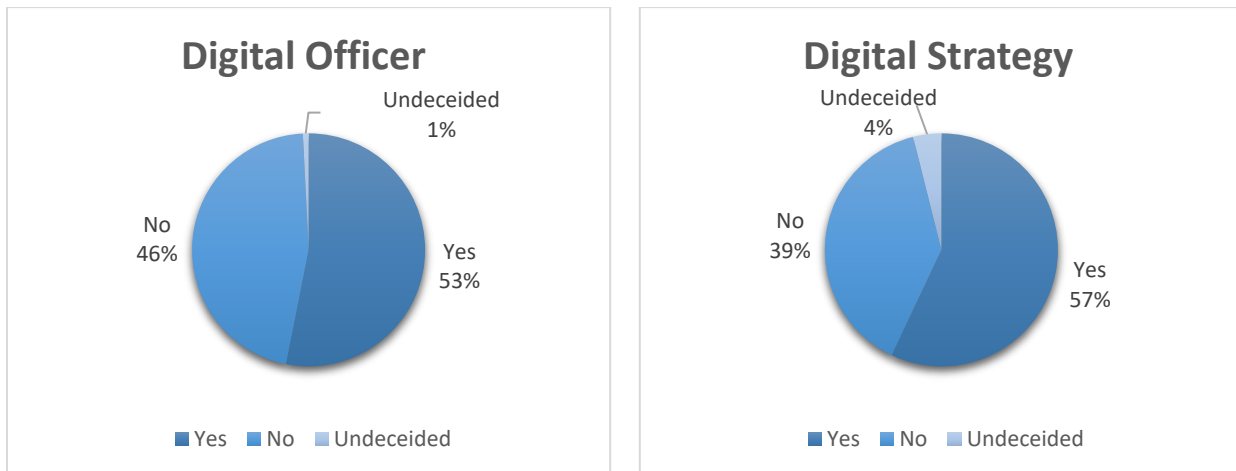


Figure 2. Existence of digital strategy and digital officers in SME in northern Rhineland-Palatinate (in per cent, n=128)

### 4.3 Importance of digital technologies

In general, great importance is attached to the implementation of digital technologies. Figure 1 illustrates, that nine out of ten respondents rate the potential of digital technologies for their own company as “high” or “very high”. Less than one per cent state that the implementation of digital technologies plays a minor role for their company.

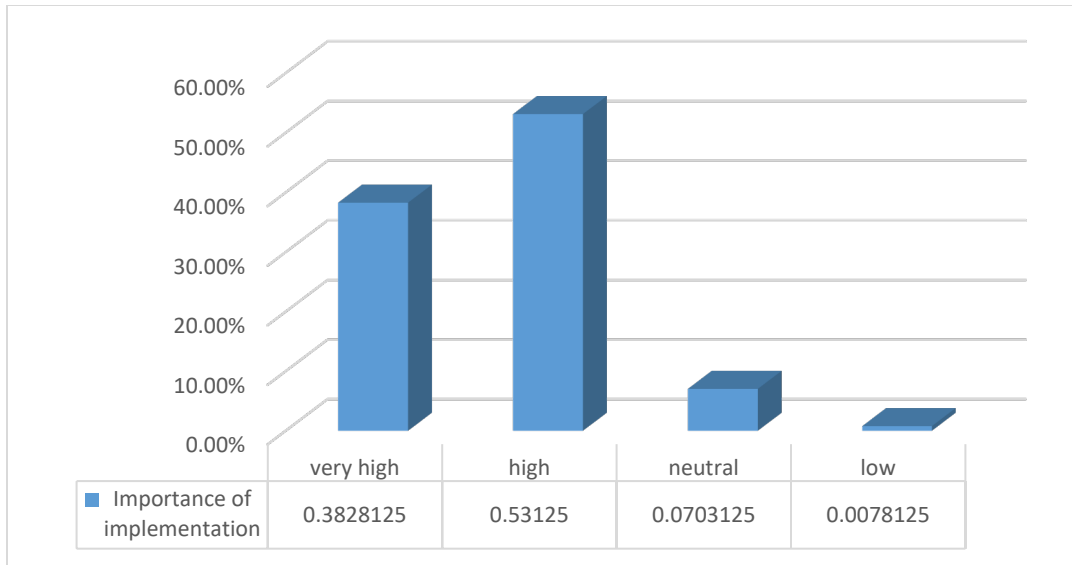


Figure 3. Importance to implement digital technologies (in per cent, n=128)

#### 4.4 Prevalence of Digital Technologies

Cross-departmental at SME, cloud applications and digital platforms are used. Furthermore, 42,1 per cent of the companies already use ERP systems. Medium-sized and large enterprises (50+ employees) it is even 3 out of 4. Self-developed or custom-made software is used by a third of the companies. Only a few subjects plan to use digital technologies in the near future. Approximately 10 percent are currently in the planning phase for all technologies. Big data (19.8%), AI (18.2%) and individual software solutions are the top 3 technologies in planning stage. Just 5% currently deal with ERP systems. Here a decision has already been made to regard the system as irrelevant (22.1%) or it is already in use. In particular, drones (58.6%), artificial intelligence (40.6%) and VR & AR (38.9%) are considered irrelevant. The terms AI, VR&AR, business intelligence software and big data are unknown to every forth subject.

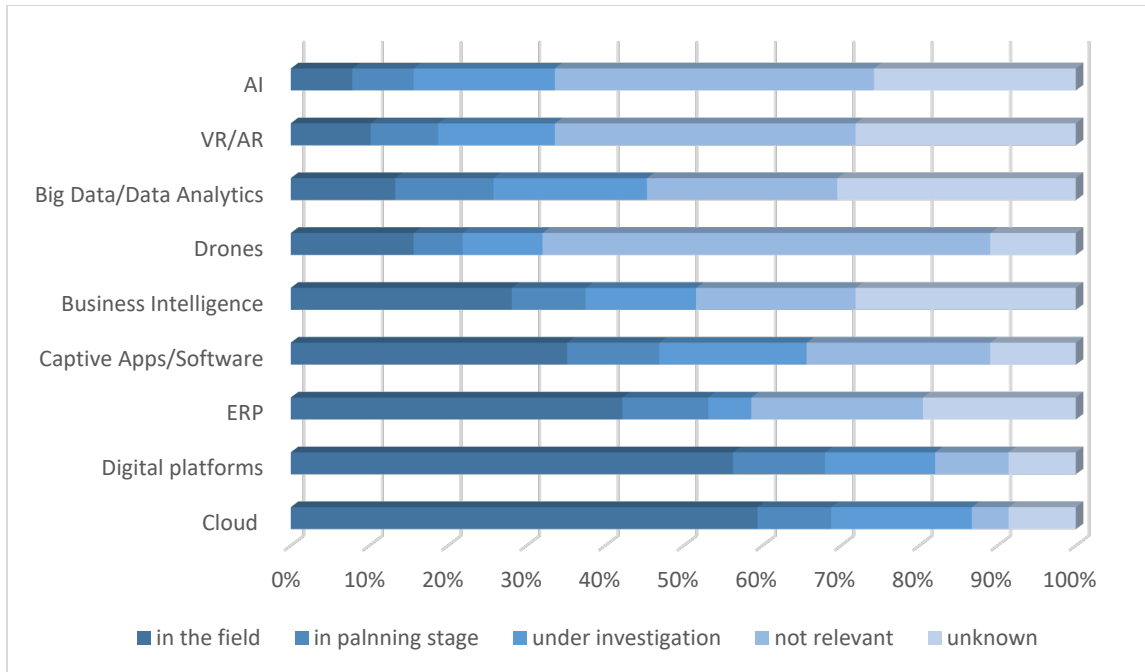


Figure 4. Cross-departmental use of digital technologies in SME (in per cent, n=128)

Search engine marketing (SEM) in particular is used in administration. Almost every second company uses SEM with its sub-disciplines search engine optimization (SEO) and search engine advertising (SEA). Above all, the service industry (62%) and primary production companies, 4 out of 6, use this digital tool. In manufacturing industry, it is just one in four companies. Only Robotic Process Automation (RPA) is increasingly used by manufacturing companies. With seven companies sharing this technology as many as in any other industry. Companies using document management systems (DMS) only, use Optical Character Recognition (OCR). A total of 57 companies out of 128 use DMS, with 50 also using OCR including two exceptions from wholesale and primary production that only use OCR without using DMS. Social Media Algorithms (SMA) and Shop Systems are primarily used by the service industry. Slightly more than every third company uses these technologies. Chatbots and Automatic Speech Recognition (ASR) are hardly used so far. Less than 10% of subjects reported using these technologies.

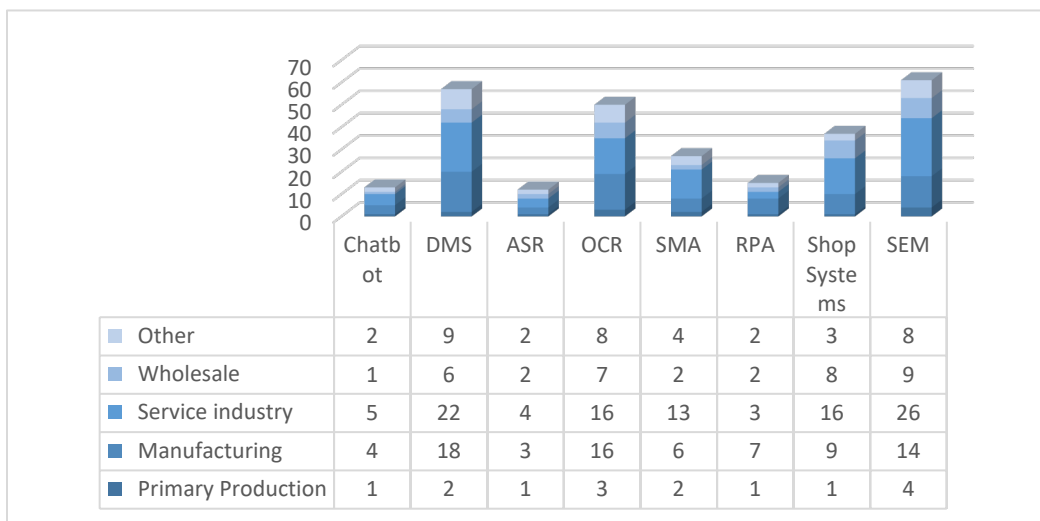


Figure 5. Use of digital technologies in administration by industry sectors

Digital measuring systems (59.5%) and 3D product animations (38.1%) are primarily used in production. Every third company already uses 3D printing in production. Digital technologies like Manufacturing Execution Systems (MES), digital twin, radio-frequency identification (RFID) or cyber physical systems (CPS) are not widespread. The latter are used at 7%. 11.9% use MES with another 16.7% planning to do so in the near future. Over 40 per cent have no idea what a MES is. Top 3 unknown digital technologies are CPS (58.4%), MES (40.5%) and digital twin (38.1%). The biggest hype is currently 5G. While only 11.9% have already deployed 5G, 38% are scanning possible use cases and the market.

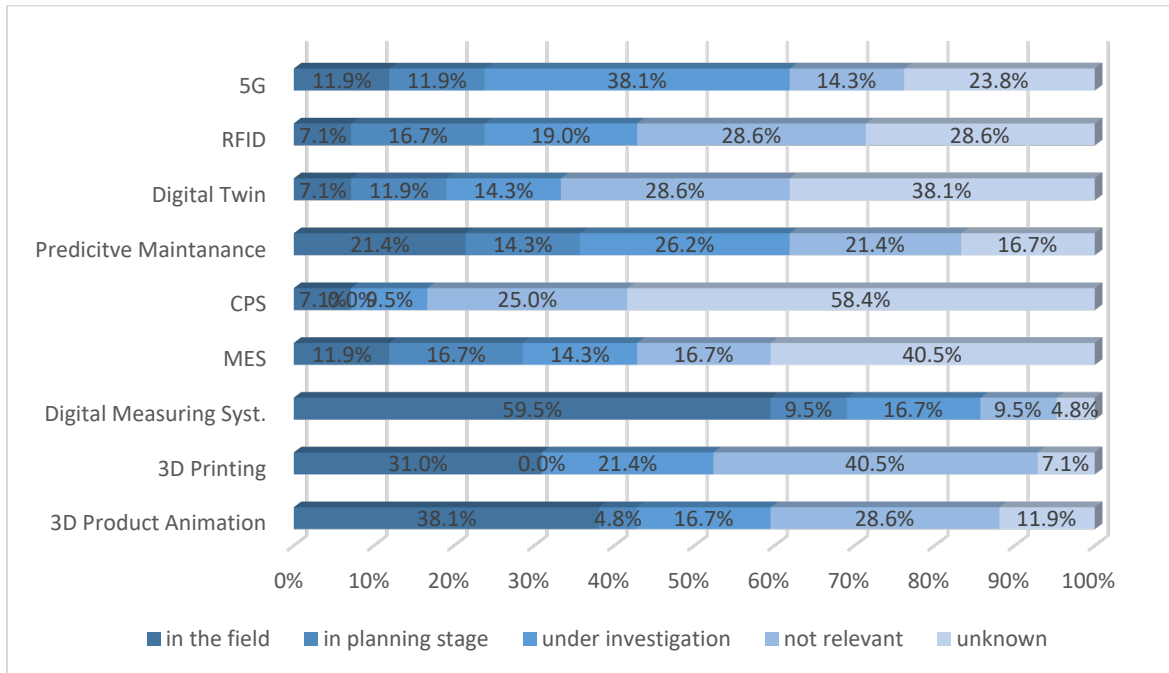


Figure 6. Prevalence of digital tools in manufacturing industry (n=53)

#### 4.5 Digitalisation Drivers in SME

In most companies, digitization is a reaction to external or internal pressure. Every fourth company names staffing requirements as the main reason for introducing digital technologies. Every second company assigns external requirements one of the two top ranks. The corona pandemic is related to the internal pressure of staffing. Anyone who indicated staffing requirements as the top rank did so in connection with Corona in rank 2. 13% named the pandemic as the main driver for digitalization. Actively seizing market opportunities is the priority for 20% of companies when it comes to digitizing their own company.

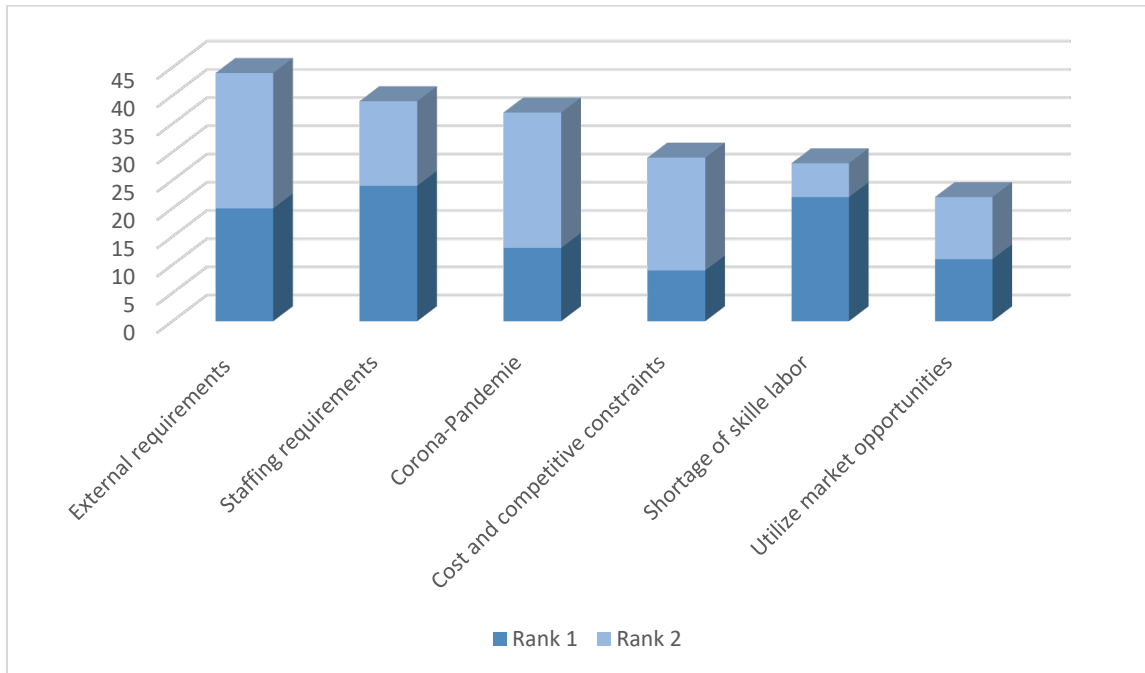


Figure 7. Ranking of digitalization drivers in SME

## 5. Discussion

### 5.1 Principal Findings

This is the largest study to date examining dissemination of digital technologies in SMEs in the northern Rhineland-Palatinate. While conducting this study via a web-based survey created a response bias - respondents are likely to be more digital savvy -, the results offer crucial insights into the current implementation status of digital technologies, suggesting potential targets for supporting actions by regional initiatives and officials.

### 5.2 Prevalence of Digital Technologies

Comparing the survey results with the technology radar (MDZ Saarbrücken 2022) and the findings of the literature research, we conclude that long-established technologies in particular are used. Overall, the assumption is confirmed that basic digital technologies are the common run for SMEs. Few pioneers fall back on innovative technologies. According to the experts in the preliminary study, SME usually wait for digital technologies to be established within their own industry, which results in an additional delay. Before digital technologies become mainstream for SMEs few pioneers have to put them into practice for a specific industry. Early adopters, public media and external experts help to popularise them. Many jump on the bandwagon as illustrated by the following exceptions:

The high use of 5G might be unexpected. Overall, one in four companies are already using 5G or planning to do so. The statement must be put into perspective. In most cases it is hardly a 5G campus network. Rather, the question behind is, whether the companies are dealing intensively with mobile communication and are therefore considering the use of 5G-capable end devices. The fundamental discussion of this question will become increasingly important for SMEs as digitization progresses, to maintain flexibility and room to maneuver. Detached from the actual communication standard.

It is also unexpected that every third manufacturing company uses 3D printing. The importance of additive manufacturing has increased in the wake of the pandemic (Choong, et al. 2020). Wherever supply chains depend on international cooperation, the current pandemic can lead to supply shortages in the short and medium term. This can range from spare parts for production machines to complete supplier components. This is where additive



manufacturing can fully exploit its advantages by delivering the required parts quickly and decentrally. The costs of the spare parts play a negligible role, since the downtime of large-scale technical systems, in general, is significantly more expensive. It is striking, that these are not the most progressive companies according to the subjects. However, all but three possess a clear digitalization strategy. This is supported by the fact that for none of these companies digitalisation is driven by the current pandemic. The lack of skilled workers is the main driver for companies that actual use 3D printing. This digital technology is already highly automated by design. The devices are controlled digitally and produce work pieces or complete products directly from print files. In combination with modern cloud solutions for automatic configuration and calibration, the systems work without human intervention. This is particularly interesting for smaller companies. They often rely on their technical know-how and experience. When it becomes difficult to find new employees, additive manufacturing allows the existing workforce to better keep up with demand.

The survey also stresses, that many SMEs create isolated solutions with individual apps or software products. Even the smallest companies are already using them. In particular, medium-sized companies see the use as necessary. Eight out of 10 companies with 50 to 249 employees use such isolated solutions. Ideally, an existing process is adapted around the digital technology. Most digital technologies are tools to improve existing processes by opening up new potential to modified processes. Consequently, individual software should not be the norm. The risk to implement isolated solution to solve a specific problem within a single process exists. In such cases the sustainable use of digital technologies is linked to the persistence of the process. A mindset that can be extended to all digital technologies. Digital technologies should not be understood as problem solvers but as chance to put the existing to the test.

### **5.3 Digital Information Gap**

The continuing implementation gap in SMEs can be traced back to a still existing information gap. This is particularly evident in the fact that SMEs that consider themselves very progressive marked many technologies as unknown. On the other hand, there are companies with a more reserved self-assessment, that know more technologies overall and already use a broader set of digital technologies respectively are planning to use them. To a certain extent, the digitization gap in SMEs starts with the lack of information on individual digital technologies or a lack of an overview of existing technologies. The existence of digitalisation officer in companies with up to 50 employees has no influence. Although the announcement of a digitalisation officer underlines the importance of the topic for SMEs, many hold this position as a part-time job. Many SMEs are reacting to the trend and the growing external pressure to deal with the topic in general, a certain seriousness in addition to the day-to-day business or specially trained staff with the freedom to tackle the change proactively is often missing. This is also evident looking at the drivers suggesting that most SMEs with digitalisation officers are reacting instead of acting. To utilize market opportunities is not a main driver in these companies. A similar picture emerges with regard to the existence of a digitization strategy. In order to be able to formulate a holistic digitization strategy, a sufficient information base is crucial. On the one hand, this applies to information about digital technologies in order to be able to define concrete use cases, but also to knowledge of holistic digitization strategies, methods and implementation examples. Without a digitalisation strategy, a sustainable and successful use of digital technologies in the longrun is not possible. The deployment solves short-term problems and, in the worst case, raises additional problems in the future. However, without knowledge of digital technologies, their existence and possible applications, a holistic strategy cannot be formulated conclusively. The problem is reflected in the lack of information about digital technologies.

It is striking is that technologies such as CPS and MES, which experts refer to as fundamental technologies for Industry 4.0 applications, are unknown to half of the manufacturing companies. Much better known are 3D printing and animations as well as 5G and drones. Technologies that do not yet have many use cases in SMEs, but are also discussed outside of the industrial context. Results show that SMEs that see digitalisation as an active role and less as a reaction to internal and external requirements, deal more intensively with digital technologies. Those who state the use of market opportunities as the main driver are not only increasingly using digital technologies in all areas, but also marked significantly fewer digital technologies as unknown. It is reasonable to assume that an active role in shaping the digital transformation leads to a more intensive examination of digital technologies and is accompanied by an active procurement and processing of information.

## **5.4 Administration is behind in manufacturing industry**

Manufacturing companies use fewer digital technologies in administration than any other sectors. This does not mean that manufacturing companies generally have a harder time with the digital transformation. Rather, it is a different way of thinking and approaching the issue. Regarding the technologies used, it becomes clear that manufacturing enterprises in the supporting areas and especially in administration use digital technologies that serve to automate and control processes. An approach that has led to significant increases in effectiveness and efficiency in production over the past few decades. These companies are increasingly using RPA and chatbots to automate existing processes. However, these technologies in particular are associated with high implementation costs. These technologies are therefore less interesting for smaller manufacturing companies. Consequently, another digitalisation gap in the administration area between producing and non-producing but especially between small and medium-sized manufacturing companies opens up. The question of how the use of digital technologies can change the work culture and processes in companies, but also their business models, remains unanswered, following an approach focusing on automation and process control.

## **6. Conclusion**

The already visible effects of the megatrends digitalisation and Industry 4.0 pose enormous challenges for German SME. As a result, companies are required to significantly increase their willingness to invest and their innovative performance, to improve their existing business and manufacturing processes gaining flexibility to adapt working environments to changing digital conditions and to develop new, innovative business models. Above all, production and cooperation networks that merge ad hoc or permanently will dominate the digital future. New digital communication options and technologies also influence the behaviour of customers, managers and employees. To exploit digital technologies full potential an increasing networking and integration of business processes, machines and IT systems as well as an increasing automation, worker support and service orientation with new business models becomes indispensable.

Overall, the participants rate themselves as more progressive than their direct competitors. In this respect, it can be assumed that the study represents a rather positive image of the prevalence of digital technologies. The outlined information gap therefore threatens to be even larger. Although most subjects are aware of the importance of digital technologies, only few deal with it intensively. Many technologies that serve as the basis for innovative applications and for increased future flexibility are not used and are often even unknown.

Digitalisation will continue to take place in two stages. First of all, the level of technization takes effect as a reaction to external or, in some cases, internal expectations. Many of the companies surveyed are in the middle of this step, which for manufacturing companies focuses in particular on production. The work on the internal workflows and digital interfaces has not been covered so far. In many cases, isolated technological solutions are created that serve to solve specific problems. However, digitalisation cannot be successful if only superficial digitalisation is carried out without changing underlying processes and roles. However, this requires an active design of the digital transformation, which in turn requires a comprehensive information base. While digitalisation as a reaction is possible through the selective procurement of information, the active design of the transformation process requires closing the information gap before single problems are addressed. If companies want to recognize and help shape market developments, for example to seize the opportunity for new business models and open up new markets, then there must be a willingness to provide consistent information at all levels. Especially in SMEs, those responsible and the corresponding employees are caught up in day-to-day business, so that it cannot go beyond selective, problem-related information. This is where offers of support have to start. Closing the information gap in medium-sized companies is therefore equivalent to solving the lack of time issue. Support offers must address this time problem by preparing information that is appropriate for the addressee. In this context, appropriateness for addressee means that content must be adapted to the current level of information in SMEs and, similar to digital maturity models must include Level 0. In other words, the technological and organizational basis for using digital technologies must not be assumed. In general, suitable maturity models must be used to orientate towards SMEs in order to ensure that the content of the offer is appropriate. However, it also means that an appropriate format must be selected that is based on the specific needs of SMEs. Future research should shift its focus on it. In particular, support offers can only be successful if they solve the time problem and do not create another time problem its-selves. Proactive support is therefore required that addresses the time component and thus supports organizations in creating the mandatory information basis and qualification.

The mere provision of information materials is no guarantee for sufficient perception and transfer of the knowledge if the respective decision-makers are not additionally given the opportunity for direct personal discussions. This includes support for networking with all stakeholders, especially with companies across industries, scientists and technical experts to enable a provider-neutral, problem-related exchange. In addition, every form of technology based knowledge is subject to rapid changes and must therefore be continuously updated.

Consequently the current digitalisation gap in German SMEs cannot resolve on its own. SME are trapped in a constantly growing information gap that is caused by a dilemma of time. Many are caught up in day-to-day business, that does not allow to build the required information basis to break established patterns and to implement comprehensive, sustainable digital solutions that on the other hand can free up time for critical information processing. The more the digitalisation gap grows the more SMEs get stuck in day-to-day business trying to keep up with highly efficient and effective processes addressing customer needs. We therefore argue, that an impulse from outside is necessary, which in a first step helps to address the time problem. Only then can the existing technical and financial support for implementation unfold its full effect.

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