

The Impact of Digital Technologies on How Companies Work: Results from an Interview Study

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Abstract—The increasing digitalization of business and society has prompted drastic changes within enterprises and confronted them with enormous challenges. In our exploratory interview study, we examined the impact of digital technologies on how employees work in companies as well as the specific opportunities and challenges that small and medium-sized enterprises (SMEs) face as a result. On the whole, interviews revealed that digitalization has already triggered an array of changes in how employees work. Even so, the extent of each change and the perception of technological trends overall have varied among both employees and companies depending on their context. In response to those changes, the SMEs interviewed have applied a wide range of tools and strategies that have allowed them to exploit the opportunities offered by digital technologies and overcome the associated challenges.

I. INTRODUCTION

SOCIETY as a whole is undergoing a rapidly evolving digital transformation, one in which governmental institutions, households, companies, and their interactions are changing due to the increasing spread of digital technologies. As a result, it has never been more important, especially for companies, to be able to rely on capabilities enabled by information technology (IT) or on a deep understanding of IT in general and digital innovation in particular. As part of the evolution of technology, digitalization provides numerous unprecedented opportunities to support and even renew business processes. In turn, those advanced technological opportunities, particularly ones that merge the physical and digital worlds, have brought about new paradigm shifts that affect all industry sectors. By extension, stable, prevailing dynamics in everyday business show that constant changes and adjustments, including digitalization, will not be the exception but the rule in economies of the future. The consequences of that development and the question of whether it should be viewed as positive or negative are omnipresent. Perhaps most saliently, formerly analog activities—reading a newspaper, for example, or buying a physical product—have acquired digital twin processes that can be performed on mobile devices at any place and at any time [1]–[6]. That trend was jolted forward by the COVID-19

pandemic, which has further disrupted how businesses operate and how traditional services are delivered. As a consequence, the digital expectations of consumers and B2B customers have reached new heights. In response, some companies have rapidly digitalized their interactions with customers and the supply chain as well as their internal operations, sometimes even by 3 to 4 years relative to their competitors [7], meaning that those competitors now face overwhelming lags in their digital capabilities.

No matter the pace of digitalization, continuous interaction with technology in both professional and personal settings has become more standard than ever before. In that environment, studying human behavior in organizations without considering the influence of IT is short-sighted [8]. For that reason, Daugherty and Carrell-Billiard [9] have used the term “human+” to describe the workforce of the digital age, whose members not only possess their pre-existing talents and knowledge but also have new, expanding sets of skills acquired by simply using digital technologies.

From that perspective, one strand of literature addresses the possibilities of improving the quality of work and of private life by employing modern technologies and compensating for their negative effects [10]. At the other extreme, another strand focuses on those negative effects and attempts to assess the consequences faced by the human workforce in particular [11]. Between those strands, many papers describe the effects of digitalization or the digital transformation of companies, usually with reference to case studies due to the subject’s topicality [12]. In both scientific studies and reports by management consultancies and market research companies, however, the effects for employees have received less attention than those for the economy.

Given the subject’s topicality and the rise of literature addressing it, having too few qualitative studies and comprehensive literature reviews may have contributed to an inconsistent definitional framework [12]. Meanwhile, only a handful of reports issued by government and private-sector interest groups, as well as only a small proportion of scientific publications, are dedicated to digitalization’s effects on small and medium-sized enterprises (SMEs). Although SMEs bear great economic significance, especially in Ger-

many, digitalization's effects in such enterprises have hardly been examined.

In contribution to the current state of research, this paper addresses the field of effects digital technologies have on how companies work. Framed by an overview of their general effects on employees, the paper specifically explores the extent to which digital technologies already play an important role in SMEs, whether employees' work practices have changed as a result, and, if so, then how. To support our argument, we conducted an interview study with SME practitioners that followed an exploratory research approach, in which we sought to investigate and identify possibilities and challenges for the work environments of SMEs as a result of using digital technologies and of digitalization in general.

To appropriately situate and present our study and its results, the paper is structured as follows. In Section II, we provide a brief theoretical background on digitalization as well as its effects on employees. Next, in Section III, we describe the methods of data collection used in our interview study. After that, in Section IV, the primary part of the paper, we provide selected results from the interview study and, in Section V, discuss those results. In Section VI, we reflect on what the results imply for practice in the form of recommendations for action, and in Section VII, we conclude the paper with an outlook for further research.

II. THEORETICAL BACKGROUND

A. Digitalization and digital transformation

Despite steady growth in scientific literature on digitalization, such research has often focused exclusively on individual technologies or industries. Even then, company-specific case studies represent only a small fraction of that overall development [13]. In effect, the state of knowledge in that area of research is highly fragmented and not always based on consistent assumptions.

That effect is already evident in the two different meanings of the terms *digitization* and *digitalization*, which are sometimes used synonymously in science and business. Whereas *digitization* describes the pure transition from analog to digital data or services, *digitalization* is used to emphasize changes in processes, value chains, and business models, among other things, that go beyond the mere digitization of existing processes and structures—that is, that create added value [14], [15]. In this paper, our focus is on the term *digitalization*, the goal of which is the digital transformation, or the digital change, of organizations—in our case, companies. Guided by that focus, our research targeted the added value resulting from interactions between digital technologies implemented at companies and the employees affected by them.

B. Impact of digitalization on employees

Bonin, Gregory, and Zierahn [16], after replicating Frey and Osborne's [11] study on the likelihood of the automation of U.S. professions in the German context, have concluded

that technologies do not necessarily displace jobs as long as employees continuously adapt their skills to new circumstances, learn to use new technologies, and focus on excelling in activities that are difficult to automate. Added to that, Autor [17] has argued that technology rarely replaces entire jobs but often complements human labor by automating individual processes and may even create additional jobs under certain circumstances. For example, individuals in managerial, professional, and technical professions involving abstract tasks can particularly benefit by being able to analyze information more easily, more cheaply, and on a larger scale by using digital technologies, as well as by spending more time on the value-adding activities of interpreting and applying the information [17]. Autor [17] has therefore identified the greatest potential for change and automation in the routine work of knowledge workers, especially in office jobs, and manufacturing workers, whose simple calculation, data collection, transmission and storage, and precise standardized production processes are ripe for digitalization. For that reason, the work environment of those occupational groups and related industries was the focus of our study.

III. RESEARCH METHODOLOGY

A. Research design

The aim of our interview study was not to generate a new theory on the basis of interpretative generalization, for the data collected for that purpose would have to be considered in the context of the respective organization [18]. Neither was the aim to explore digital transformation in general, given that a comprehensive and growing body of literature on that topic already exists. On the contrary, our interview study, following an exploratory research design, sought to uncover seldom-observed problems created by digitalization's impacts on employees in light of the experiences of practitioners themselves. To that end, we decided to employ a qualitative approach that considers the personal perceptions, motives, background, and experience of experts in a more comprehensive, detailed way than possible with any quantitative approach [19]. More specifically, our approach can be regarded as systematizing expert interviews of an explorative character and that foreground the data's thematic comparability [20]. To ensure such comparability of the interview results, the interviews were conducted using a semistructured interview guide.

B. Selection of experts

Relevant experts were executives and managing directors of SMEs who have both insights into the technological infrastructure of their companies and can assess that infrastructure's impact on their personal work methods and those of their colleagues. To be able to compare the experts' statements, the search was limited to two specific industry sectors whose adoption of digital technologies shows extraordinary potential [17]: B2B manufacturing and banking. Ac-

cordingly, 90 SMEs were sent a cover letter regarding the study via email, and we were ultimately able to conduct interviews with 14 experts. In both sectors, the same number of experts was interviewed. Table I in Appendix B provides an overview of the interviewed companies and the positions of the expert interviewees.

C. Data collection and analysis

The interview guide consisted of four blocks of questions, each with four to six primary questions, along with situational follow-up and sub-questions to be asked as needed: (1) general questions, (2) flexibility via digitalization, (3) data analysis, and (4) automation. The interview guide with each block's primary questions appears in Appendix A.

All 14 expert interviews were conducted over the phone between February 25 and April 16, 2020, and proceeded according to the interview guide, which had previously been sent to the experts via email for preparation. The interviews, varying in length from approximately 35 minutes to 2 hours, were recorded with the consent of the interviewees and fully transcribed and anonymized, with dialects and grammatical errors in the conversations partly transcribed into standard language to make the content more comprehensible [21]. Before analysis, the experts received the opportunity to make further requests for changes, and approval was obtained for the selected degree of anonymization.

The subsequent, computer-assisted coding of relevant text passages was conducted using the data analysis software MAXQDA 12. The coding system used was based, on the one hand, on the structure of the interview guide in order to enable the clearest, most systematic coding possible. On the other, care was taken to ensure that the theses derived from the literature search could later be discussed in a differentiated manner for each industry sector. The coding system was tested in the first three interviews, minor changes were made (e.g., the code "digital departments/responsible persons" was inserted in the area "digital transformation" because new departments had been created in all companies in recent years), and then retained for all subsequent interviews.

IV. INTERVIEW RESULTS

Building on the preliminary literature review, the expert interviews confirmed numerous theoretical sources of potential and challenges posed by digital technologies and trends for SMEs. Overall, the interview study's results supported the assumption that SMEs in the industry sectors under consideration (i.e., manufacturing in the B2B sector and the banking industry) face additional challenges relative to larger companies. The ways how SMEs work have also been decisively influenced by digitalization, and it is evident general deductions from research findings only reflect part of the reality in companies and should therefore be supplemented with more specific findings from practice in order to appropriately assess the impact of digital technologies. The interviews revealed that perceptions of digital change and associated internal company developments are industry-

company- and person-specific, which is why the sources of potential and challenges identified always need to be considered in their respective contexts in order for the reasons for the assessments made to be understood. For example, the reduction of personnel can be seen as both an opportunity and a risk depending on the context, and the assessment can differ not only within an industry sector but also within a company.

A. Differences between the industry sectors

As expected, differences emerged between the two industry sectors in terms of the reasons for digitalization and its various forms. The SME banks examined view themselves as service providers, such that the demand of their customers for digital offerings primarily drives their digital transformations at the process and product levels. The study did not reveal any company in the banking sector that continues to exist in the market without a minimum level of digital processes and offerings. In manufacturing in the B2B sector, by contrast, the products and development services have not necessarily changed. Instead, new and complementary digital services are emerging in isolated cases, and some companies, including the manufacturer of control solutions M, exhibit a trend of offering complete solutions instead of pure products, although most of the changes described had occurred at the process level. In that case, digitalization has been driven by the overall market and the companies themselves in order to remain competitive. However, examples such as the measurement technology manufacturer L show that even manufacturers with a comparatively low level of digitalization can currently hold their position against the competition. Despite those differences, both banks and manufacturing companies are increasingly developing into technology companies in the course of the third and fourth industrial revolutions (Experts C and D). No expert explicitly assumed that their company could survive in the market in the long term without its own know-how in digitalization and the use of digital technologies. Other digital technologies described by the interviewees imply that SMEs have already begun working with innovative technologies (e.g., distributed ledger technologies or cryptocurrencies in the banking sector).

However, the extent to which that development toward becoming a digitalized company will continue cannot be determined based on the industry sector alone. The different types of value creation and other factors, including specific regulations in the banking sector or dependencies in the manufacturing industry, do not necessarily influence the current state of digitalization but do influence the type of technologies used and their method of implementation. Saam et al. [22] concluded that, due to a lack of digitalization strategies, the majority of German SMEs are not yet engaging the process of digital transformation. However, according to our results, that conclusion does not or no longer applies. All 14 SMEs exhibited changes and developments in aspects of

digitalization and thus seemed to have already initiated the process of digital transformation, albeit at different stages.

B. Differences between the companies

Differences also surfaced between the individual SMEs in the sectors examined. For one, a direct correlation between the number of employees and the perceived sources of potential and challenges, as well as the forms of the implementation of digital technologies, cannot be derived from the interview results. Current and future opportunities are also limited by financial, cultural, and business model-specific factors that do not necessarily correlate with company size. Pioneers in using new technologies and automation, including the automotive electronics manufacturer N and the direct banks E and K, even have comparatively small staffs, possibly due to a higher degree of digitalization and automation. Compared with the other companies interviewed, those digital pioneers have clearly already recognized the added value of digitalization for their business models, as was the case with the automotive electronics manufacturer N and the B2B manufacturer of fully automatic coffee machines C. Otherwise, their business models have always been based on digital technologies, as in the case of the direct banks (E and K). Other medium-sized manufacturing companies—for example, the metal industry company F and the furniture manufacturer G—lack the necessary production size or quantity of identical parts relative to the pioneers, despite the need for such parts in order to standardize and automate their production and thereby create a basis for Industry 4.0 concepts. In addition to a lack of starting points for automation, financial aspects could also discourage efforts at strategic automation in medium-sized companies. Expert N, for instance, reported that a fully automated production line would require investments ranging in the tens of millions.

C. Effects of technologies used

None of the interviewees indicated a clear distinction between data-driven processes and data-driven decisions, most likely because similar data foundations often form the starting point for operational and strategic decisions. At the same time, many data analytics are examples of automation and the provision of a digital IT infrastructure and enable virtual collaboration among employees and with partners and customers. Various cases revealed that digitalization in companies usually empowers but does not automatically support or stimulate change or facilitate work, regardless of whether it involves technological infrastructure or applications. For example, whereas current software systems offer many opportunities to support work processes, systems that have been implemented in ill-conceived ways can ultimately create more work and undermine efficiency (Experts H and M).

According to Expert G, more extensive databases enable deeper analyses but do not automatically simplify the understanding of one's company due to the increased complexity entailed. According to [23] and Expert N, although increased networking and automation as part of Industry 4.0 enable flatter hierarchies, and although all of the companies inter-

viewed are using IT that simplifies exchange between hierarchical levels, in no case have those trends automatically yielded a flatter organizational structure or cross-hierarchical collaboration. On the contrary, changes in management and corporate culture are seen as triggers for those developments (Experts A, B, and J). That view of technology as purely an enabler redoubles the emphasis on positioning people as decision-makers, installers, and users of the technology.

V. DISCUSSION

In what follows, four theses consolidated from the results of the literature review are discussed and differentiated against the background of the findings from the expert interviews.

Thesis 1: The virtualization of processes and simplified access to software and data via cloud computing and private devices give employees greater flexibility regarding the time, place, and design of their work. However, a lack of trust and of control options continues to decelerate that development. As a result, the boundaries between work and private life are becoming increasingly fluid.

All experts described increased flexibility in their day-to-day work and throughout their companies as being a result of digitalization efforts. To achieve those assets, all companies enable data access beyond their company sites via not only cloud solutions but also VPNs or remote desktop connections. Thus, cloud solutions have been primarily used in the SMEs interviewed (i.e., 12 of the 14 SMEs) to boost the flexibility of work. The two remaining companies reported currently debating whether they would implement cloud solutions.

At the same time, from a technological viewpoint, all companies afford the option of working from home, although such potential is not being exploited in every company interviewed. On the one hand, that tendency is due to activities in production and/or customer consulting, which are tied to fixed workplaces and times due to their work content. Thus, even for work activities that could be performed outside the company sites, the option of using a home office is sometimes waived by employees. One reason could be that employees of SMEs, as in the example of direct bank E, often have short travel distances and enjoy working together in person (Expert E). However, the interview results, as the academic literature similarly shows, also indicate a lack of trust on the part of managers as a reason why employees are less likely to work from home than they would like (Experts K and M). For that same reason, the spread of trust-based working hours also seems to have been inhibited; thus far, employees primarily at higher levels of the organizations' hierarchy have pursued the possibilities of remote work and trust-based working hours. At lower levels of the hierarchy, by contrast, the unverifiable nature of remotely performed services is presumably the most important cause for distrust on the part of managers, for work performance in most companies continues to be determined in hours, not according to

measurable results. However, as per some interviewees (Experts I and N), the COVID-19 pandemic has spurred rethinking about how work can be performed, as many companies became forced to switch to work-from-home models and thus gained experience with digitalization.

All of the interviewed experts stated that the boundaries between their personal work and private lives were becoming increasingly blurred. However, that tendency is largely justified by their professional development and the responsibility borne within the scope of their current jobs, not by new technological opportunities available to them. Another reason given was that companies respect their employees' personal lives and do not require them to be continuously available or to work beyond business hours (Expert D). On the whole, the interviews suggested that employees themselves can somewhat influence the separation of work and private life, depending on how strongly the companies support such separation and how much the employees prefer to work beyond the work hours required (Expert K).

***Thesis 2:** The further development of IT and increasing spread of social networks simplify communication within and between companies. However, the resulting decrease in personal interaction makes that communication less clear and team-internal coordination more complex.*

All of the companies interviewed offer a wide range of communication channels, such that contact increasingly occurs not only in person but also via email, telephone, video conference, intranet, and/or collaborative documents. However, in some companies, the potential of digital communication channels remains limited by a lack of sufficient Internet access (Experts H and L). At the same time, despite their theoretical potential as one such channel, social networks were not reported to be relevant in the experts' professional contexts, largely owing to the uncertain safety of exchanging business data via those channels and the preference for secure, direct means of communication (Experts M and H).

Overall, however, the share of virtual communication has increased in both industry sectors investigated, both for coordination within teams and throughout companies and to reduce the effort and cost of face-to-face meetings and central events. However, the greater flexibility possible in selecting personnel reported in the literature [24] was not characterized by interviewees as an advantage of working in virtual teams, partly due to the low degree of internationalization and the focus on local employees. Digital channels are also becoming increasingly important in customer–company contact, especially after initial personal contact, for they save time and costs and can create new offerings—for example, video consulting with banks and various services in the manufacturing industry. That development will continue but not completely replace personal contact, the experts unanimously agreed, given the importance of informal communication and the building of trust (Experts A, G, and M).

The experts' statements also confirm a real or feared decrease in uniqueness in the results of work due to intense virtual communication. Even so, the experts did not describe more complex internal team coordination as being a challenge. Expert A suggested that different personality types might also influence the preferred way of working together, an assumption supported by past research [25] showing that individuals most suited to virtual collaboration are ones who are open to new environments and who prefer short, targeted discussions and rapid decision-making. The results of that study also suggest that extroverts prefer to collaborate face-to-face but prefer virtual teams to working independently, whereas introverts can adapt more quickly to work on virtual teams because they have to expend less energy than in face-to-face interactions. Those deductions emphasize the importance of personality and cognitive style as factors influencing the success of working in virtual teams and at home offices.

***Thesis 3:** Via digitalization, internal and external ideas (e.g., from customers) to the company can be more easily created, tested, integrated into innovations, and scaled in digital form. Nevertheless, bringing innovations to market remains complex.*

According to the interviewees, ideas for innovative projects have come from all departments and hierarchical levels in their SMEs, some of which have been technologically supported by supplying idea management platforms that simplify the collection and evaluation of ideas (Experts A, M, and N). In both industries, increased collaboration between departments and permeability between hierarchical levels can be observed, which has consequently increased the importance of ideas from all employees compared with ideas from individual decision makers and individual departments (e.g., R & D). Companies such as Volksbank A have also enabled and explicitly encouraged their employees to share their ideas (Expert A).

To date, the theoretical potential of digital innovations has had only a minor impact on manufacturing in the B2B sector, where the focus continues to be the further development of haptic core products instead. To test those products, prototypes are already being created in some of the SMEs using 3D printers; however, they have neither been fixed components of innovation processes nor benefited series production. Only a few companies already offer supplementary digital services along with their core products, possibly due to the technical complexity of such development (Experts F and G) and/or a lack of demand in the B2B market. However, similar to 3D printing, complementary services are seen as having tremendous potential in the future.

Thesis 3 applies more strongly to the banking sector. In recent years, the demand for digital services and consulting offerings has increased, as has customers' use of online branches and banking apps, such that the potential for digital

innovations has also increased beyond purely in-house solutions. The banking interviewees reported that their organizations were digitizing their core products and services, whereas doing so is more difficult, if not impossible, in the manufacturing industry. In that context, the importance of IT providers also becomes apparent. Excluding the direct banks, the smaller banks in the sample were described as using central IT service providers, which are thus responsible not only for managing the central IT infrastructure but also for creating central, digital product and service innovations in collaboration with the banks (Experts A, B, and D).

By contrast, the model for success of fintech companies is to create quickly scalable, innovative solutions and platforms in a short period, which requires very little infrastructure and precludes having to meet as many regulatory requirements as companies with a banking license would have to meet (Expert H). However, in many cases, fintech companies also need partners, either to test solutions or to integrate them with services from other providers. Collaborating with fintech companies also plays an increasingly important role for banks such as Volksbank A and direct bank E, as mentioned by their respective experts.

***Thesis 4:** The impact of digital technologies on the labor market is primarily limited to the loss of repetitive, clearly defined activities, not entire professions. Moreover, new activities and professions are created through their use. Advances in artificial intelligence (AI), however, could increase possibilities for automating activities that are more demanding.*

Although the greatest changes due to automation have occurred in simple production and service activities, none of the companies interviewed have had to significantly reduce the scope of the jobs affected. Instead, for example, the B2B manufacturer of fully automatic coffee machines C made the strategic decision to not further automate certain work processes (Expert C). Along with the resources available to SMEs for technical automation, other factors—the availability of labor, the business model, and measures taken to expand and enhance employees’ skills—can also reduce the extent of digitalization’s effects on employment. In line with past deductions [16], the interviewed experts agreed that new tasks and added value for employees have to be found or developed as automation intensifies and that willingness and ability to change are important competencies to that end.

The changes described in the everyday lives of the experts also suggest that automation in SMEs has already reached impressive heights, at least in certain business areas, and is increasingly becoming the standard. However, that no expert reported having more time due to using digital technologies also implies that the changes triggered by automation do seem not permanent. Instead, outsourcing one’s activities to software or machines becomes the standard after a certain time, and the time saved is continuously replenished with

new tasks. Those factors could explain why some experts struggled to identify and describe automated processes in their respective environments. Regarding the manufacturing sector, the interviews revealed trends that reflect past findings ([26], [27]), namely that collecting data and using digital technologies have so far been aimed at controlling and optimizing plants, not automating or autonomizing them. However, as interviewees at the automotive electronics manufacturer N and plastics industry company J revealed and in contrast to published findings ([26]), investments are being made in not only lower-cost technologies such as cloud computing but also in innovative, automated production lines (Experts J and N).

The second claim of the thesis, concerning newly created jobs, can be justified by two effects, as the results of the interviews suggest. On the one hand, using digital technologies can secure the competitiveness of companies and thus company growth and jobs (Experts H and N). On the other, two-thirds of the experts (Experts A–E, I, K, L, and N) occupy positions directly created by digital technologies in recent years and that involve dealing with them. For that reason, the SME representatives interviewed seemed largely aware of digitalization’s operational and strategic importance, and their organizations seem to be increasingly embedding it in their operations. On top of that, the jobs created exemplify professions with job profiles described by the experts as being less susceptible to automation and thus as the most important fields of human activity. Those activities involve monitoring and shaping digitalization, making strategic decisions and assuming responsibility, and engaging in activities characterized by a high degree of trust and communication.

Regarding the third claim of the thesis, the expert interviews provided little evidence that learning, artificially intelligent systems already play a role in the automation of demanding activities or even entire professions at SMEs. In the case of direct bank E, the system used to check credit applications is largely a rule-based activity, and the AI system for fraud prevention at direct bank K analyzes transactions executed on the basis of rules as well, albeit without recommending or initiating action independently (Experts E and K). The low prevalence of advanced AI systems could stem from the lack of areas of application, technological competence, and sufficient databases in SMEs for deep learning algorithms (Expert D). In the future, the first systems for more complex application areas are planned with chatbots for automatic interaction with customers (Expert I) and visual control of surfaces in production processes (Expert J). Even technically skilled interviewees such as Experts D and K attested to the limits of AI systems in human activities that are difficult to automate and need an extent of creativity that often cannot be provided or covered by such systems.

VI. RECOMMENDATIONS FOR ACTION

In what follows, to help SME managers to tap into the identified potential of digital technologies and to overcome

the challenges associated with that endeavor, we make specific, cross-industry recommendations for action in four domains of activity.

First, contact restrictions during the COVID-19 pandemic have again shown that companies accommodating time- and location-independent work can respond more flexibly to changes. The pandemic has had positive effects on collaboration and future ways of working as well, in addition to having catalyzed virtualization and the accelerated transformation of organizations via digitalization [28]. According to Expert N, SMEs should primarily allow employees to work from home if they are well suited to that way of working and if it suits their job profile. New forms of measuring performance unrelated to hours worked and the use of improved digital reporting and monitoring tools could boost trust in the effectiveness of remote employees. As in the customer–company relationship, trust in teams should nevertheless initially be built through personal contact before communicating predominantly via virtual channels. Plus, at that point, video instead of telephone conferences are recommended for sustained virtual contact.

Second, to manage the complexity and speed of technological development, SMEs should develop a data and digitalization strategy with specific steps. The results of the expert interviews indicate that complex technologies such as distributed ledger technologies and AI applications will become increasingly important for SMEs in the future. For that reason, SMEs should begin examining possible applications and strategic roadmaps in order to avoid missing the starting gun for a successful digital transformation.

Third, wherever possible, operational and strategic decisions should be supported by data analyses in order to increase the quality of decision-making. Because an insufficient basis of data was often a challenge for the SMEs, rapid, digital testing methods should be used to expand that basis and/or to verify decisions. Especially when no decision-relevant data are available and speed is a pivotal factor, decisions should be made intuitively and in consultation with knowledgeable employees.

Fourth, in the SMEs interviewed, losses of employment due to automation had occurred in only a few cases, which can be attributed to active measures in addition to company growth. Companies that want to retain employees whose jobs have been adversely affected by digitalization should, similar to cooperative bank D, facilitate trial work and transfers to other jobs and departments (Expert D) and/or invest in the further training and retraining of those employees at an early stage. Another option is to prepare a skills matrix that enables the targeted deployment of employees in other activities according to a job rotation model (Expert C) or the expansion of the previous activity to include suitable, more automation-resistant tasks according to a job enrichment model.

VII. CONCLUSION AND FURTHER RESEARCH

The aim of our work was to identify the influence of digital technologies and trends on how companies work and what specific sources of potential and challenges SMEs have faced in the digital transformation. Therefore, as a primary part of our study, 14 semistructured expert interviews were conducted with executives at SMEs in the banking and manufacturing sectors, which we later systematically analyzed.

Altogether, the results suggest that digitalization has already triggered an array of changes in how companies work and will continue to do so in the future. The individual extent of the changes depends on, among other things, the industry sector, the business model, and degree of digitalization, as well as the job of the employee concerned. Therefore, our observations and the observations of the experts should always be interpreted in their respective contexts. Considering those factors, the findings from the scientific literature can largely be transferred to practice in SMEs. In the companies interviewed in both sectors, digitalization has prompted new forms of decision-making, increased flexibility in the choice of where and when to work, a change in how ideas and innovations are handled, new digital forms of communication and collaboration among employees or with customers, and the increased automation of simple, repetitive activities. The work methods of the experts interviewed, whose activities as managers are characterized by significant complexity and responsibility, have also changed as a result of digitalization. On average, their professional tasks have become more demanding and varied in recent years, and digital technologies have enabled the more efficient, more flexible, and sometimes more creative processing of tasks. As a result, instead of the experts' having more free time available, the activities performed have come to be perceived as denser. Added to that, the experts believe that the boundary between work and private life is becoming increasingly blurred, although that finding could be due to the experts' professional backgrounds.

Sources of potential and challenges amid digitalization pinpointed in the scientific literature were also largely confirmed by the experts' specific experiences and statements about future projects in their companies. The interviews revealed that digitalization, as a whole and in each of its technological trends, is associated with both opportunities and risks for companies. The experts' assessments of their respective companies differed only slightly depending on the industry sector. In both sectors, however, important sources of potential mentioned were greater flexibility with location- and time-independent work, easier communication via digital channels, better operational and strategic decisions, and more individualized customer-oriented offerings and approaches thanks to data analysis, as well as greater compliance and efficiency due to the automation of processes. Theoretical sources of potential for IT consumerization, by contrast, were not widely perceived by the SME personnel interviewed; however, increased sources of potential and challenges for Industry 4.0 were anticipated in the future due to

the developing status of the companies. Challenges that were perceived by the experts included concerns with data protection, the lack of network expansion in rural regions, a decline in personal interaction, problems with data collection and analysis, high investment costs for digital technologies, and a great demand for further training to improve specific digital know-how within the companies.

Major differences in the type of technology used and the way in which it is implemented can be attributed both to external factors (e.g., regulations in the banking sector) and internal factors (e.g., forms of value creation and the business model used). Therefore, challenges with implementation for SMEs include access to sufficiently large amounts of data and corresponding specialists in the banking industry able to use predictive analytics and higher-performance deep learning algorithms, as well as the automation of production facilities if their volumes are too low or their product varieties too large.

In contribution to the current state of research on the effects of digitalization, this paper has provided, via expert interviews in two industry sectors with great potential for change, in-depth practical insights into specific areas for the application of digital technologies and into their effects. The differences between the selected industry sectors, as well as between the SME personnel interviewed, represent a broad scope of investigation. The results of the interviews specifically supplement literature on the state of research in the field with experience reports and assessments from an underrepresented viewpoint in the scientific literature: the viewpoint of SMEs.

It was not our aim to generate results that could be regarded as representative of the entire market. The industry sectors sampled were selected for their high potential of automation but are not representative of all SMEs in Germany. In some cases, due to differences between the sectors or the diversity within the manufacturing industry, a comparison within the same sector is possible only under certain conditions. For that reason, the results of our study cannot be readily applied to other industries. Further research could re-purpose those limitations as an impetus to examine the transferability of the results, first to related industries (e.g., the insurance industry or manufacturing in the B2C sector) by using a similar research approach and, in turn, to other industries such as retail, agriculture, or health care. A larger, more diverse empirical approach would also allow determining the influence of factors such as company size, business model, or financial resources available. It is also expected that, due to the selection criteria chosen and self-selection effects, the experts in our panel were particularly familiar with digital technologies, and their assessments are therefore subject to a certain bias. The assessments of employees without managerial responsibility or representatives of other company departments (e.g., human resources, operations, finance, and logistics) in the manufacturing sector could be determined only indirectly in our study. Further research could thus involve supplementary interviews and focus specifically on the

differences between the different corporate divisions and hierarchical levels.

The insights gained into digital technologies also offer starting points for further research. Future studies could, for example, examine the impact of technologies currently still in development, including blockchain and cryptocurrencies in the banking industry and autonomous driving in the manufacturing industry. Initial findings from business-focused surveys conducted around the world indicate that up to 70% of SMEs have intensified their use of digital technologies as a result of the COVID-19 pandemic [29]. Therefore, the pandemic's influence on the acceptance of remote work or the spread of virtual teams also presents an interesting area of research. In all, the specific sources of potential for using digital technologies to solve the current and future challenges identified highlight the relevance of further research on digital transformation.

APPENDICES

Appendix A: Interview guide

Question Block A: General questions

1. Do you see digital transformation as an opportunity or a risk for your company?
2. Which business unit of your company is most affected by digital transformation?
3. How do you assess the relevance of market changes and accommodate them in your company's or your own business activities?
4. Has digitalization led to changes in your company's hierarchy?
5. Which effects do IT and digital technologies have on your company's innovation processes?

Question Block B: Flexibility via digitalization

6. Has IT made you and your company more flexible overall?
7. Do you know about and use cloud services?
8. Private mobile devices and networks are increasingly used for professional purposes. What do you think about that development?
9. Do employees in your company work together virtually, and, if so, are there cases in which virtual interaction is the only form of interaction?

Question Block C: Data analysis

10. What significance do data and data analytics have in your everyday work life?
11. Are your company's IT infrastructure and organizational structure designed for increasing data volumes and data analysis?
12. Do you use any forms of technology to improve your strategic decision-making?

13. Artificial intelligence is developing rapidly and considered to have great potential. Have you already explored areas where AI could be applied in your company?

Question Block D: Automation

14. Has your company gained any experience with process automation?

15. Would you say that support with technological processes allows you to

a) have more time?

b) perform more creative tasks?

c) have a more varied job?

d) work on more demanding tasks?

16. Are you worried about losing your job as a result of automation?

17. What meaning does “Industry 4.0” have for you and your business sector?

18. What role do you see for employees in the future of Industry 4.0?

19. Which other digital technologies will alter how people work in the future?

Appendix B: Experts and companies interviewed

TABLE I.
OVERVIEW OF THE INTERVIEWEES

Interviewees		Companies		
Label	Job title	Type and label	Number of employees	Industry
Expert C	Chief Digital Officer	B2B manufacturer of fully automatic coffee machines C	400–450	Manufacturing
Expert F	General Manager	Metal industry company F	350–400	
Expert G	General Manager	Furniture manufacturer G	150–200	
Expert J	General Manager	Plastics company J	150–200	
Expert L	Innovation Project Manager	Manufacturer of measurement technology L	50–100	
Expert M	Manager Marketing and Communication	Control solutions manufacturer M	350–400	
Expert N	Corporate Development Manager	Automotive electronics manufacturer N	250–300	
Expert A	Head of Strategic Further Development	Volksbank A	150–200	Banking
Expert B	Head of the Digital Business Model Department	Sparkasse B	300–350	
Expert D	Senior Expert Innovation Technology	Cooperative bank D	650–700	
Expert E	Chief Digital Officer	Direct bank E	150–200	
Expert H	Head of Strategic Partnerships	Factoring bank H	250–300	
Expert I	Chief Digital Officer	Sparkasse I	500–550	
Expert K	Ex-Head of APIs and Open Banking Platforms	Direct bank K	300–350	

REFERENCES

- [1] K. G. Gökçe and O. Dogerlioglu, "‘Bring your own device’ policies: Perspectives of both employees and organizations," *Knowl. Manag. E-Learn. Int. J.*, vol. 11, no. 2, pp. 233–246, 2019, doi: 10.34105/j.kmel.2019.11.012.
- [2] C. Leyh, T. Schäffer, K. Bley, and S. Forstnhäusler, "Assessing the IT and Software Landscapes of Industry 4.0-Enterprises: The Maturity Model SIMMI 4.0," in *Information Technology for Management: New Ideas and Real Solutions*, vol. 277, E. Ziemba, Ed. Heidelberg, New York: Springer, 2017, pp. 103–119. doi: 10.1007/978-3-319-53076-5_6.
- [3] M. Pagani, "Digital Business Strategy and Value Creation: Framing the Dynamic Cycle of Control Points," *MIS Q.*, vol. 37, no. 2, pp. 617–632, 2013, doi: 10.25300/MISQ/2013/37.2.13.
- [4] C. Leyh, S. Martin, and T. Schäffer, "Analyzing Industry 4.0 Models with Focus on Lean Production Aspects," in *Information Technology for Management. Ongoing Research and Development*, vol. 311, E. Ziemba, Ed. Cham: Springer, 2018, pp. 114–130. doi: 10.1007/978-3-319-77721-4_7.
- [5] S. Mathrani, A. Mathrani, and D. Viehland, "Using enterprise systems to realize digital business strategies," *J. Enterp. Inf. Manag.*, vol. 26, no. 4, pp. 363–386, 2013, doi: 10.1108/JEIM-01-2012-0003.
- [6] K. Bley, C. Leyh, and T. Schäffer, "Digitization of German Enterprises in the Production Sector - Do they know how ‘digitized’ they are?," in *Proceedings of the 22nd Americas Conference on Information Systems (AMCIS 2016)*, 2016.
- [7] L. LaBerge, C. O’Toole, J. Schneider, and K. Smaje, "How COVID-19 has pushed companies over the technology tipping point—and transformed business forever," McKinsey & Company, 2020.
- [8] R. F. Zammuto, T. L. Griffith, A. Majchrzak, D. J. Dougherty, and S. Faraj, "Information Technology and the Changing Fabric of Organization," *Organ. Sci.*, vol. 18, no. 5, pp. 749–762, 2007, doi: 10.1287/orsc.1070.0307.
- [9] P. Daugherty and M. Carrel-Billiard, "The Post-Digital Era is Upon Us: Are you ready for what’s next?," Accenture, 2019.
- [10] J. Bughin *et al.*, "Tech for Good: Smoothing disruption, improving well-being," McKinsey Global Institute, 2019.
- [11] C. B. Frey and M. A. Osborne, "The future of employment: How susceptible are jobs to computerisation?," Oxford Martin Programme on Technology and Employment, 2013.
- [12] E. Henriette, M. Feki, and I. Boughzala, "The Shape of Digital Transformation: A Systematic Literature Review," in *Proceedings of the 9th Mediterranean Conference on Information Systems (MCIS 2015)*, 2015.
- [13] P. Parviainen, M. Tihinen, J. Kääriäinen, and S. Teppola, "Tackling the digitalization challenge: how to benefit from digitalization in practice," *Int. J. Inf. Syst. Proj. Manag.*, vol. 5, no. 1, pp. 63–77, 2017, doi: 10.12821/ijispm050104.
- [14] F. Nwaiwu, "Review and Comparison of Conceptual Frameworks on Digital Business Transformation," *J. Compet.*, vol. 10, no. 3, pp. 86–100, 2018, doi: 10.7441/joc.2018.03.06.
- [15] I. Mergel, N. Edelmann, and N. Haug, "Defining digital transformation: Results from expert interviews," *Gov. Inf. Q.*, vol. 36, no. 4, 2019, doi: 10.1016/j.giq.2019.06.002.
- [16] H. Bonin, T. Gregory, and U. Zierahn, "Übertragung der Studie von Frey/Osborne (2013) auf Deutschland," *ZEW - Zentrum für Europäische Wirtschaftsforschung GmbH*, Mannheim, Kurzexpertise No. 57, 2015.
- [17] D. H. Autor, "Why Are There Still So Many Jobs? The History and Future of Workplace Automation," *J. Econ. Perspect.*, vol. 29, no. 3, pp. 3–30, 2015, doi: 10.1257/jep.29.3.3.
- [18] K. Yilmaz, "Comparison of Quantitative and Qualitative Research Traditions: epistemological, theoretical, and methodological differences," *Eur. J. Educ.*, vol. 48, no. 2, pp. 311–325, 2013, doi: 10.1111/ejed.12014.
- [19] J. Recker, *Scientific Research in Information Systems*. Berlin, Heidelberg: Springer, 2013. doi: 10.1007/978-3-642-30048-6.
- [20] A. Bogner and W. Menz, "Das theoriegenerierende Experteninterview," in *Das Experteninterview*, A. Bogner, B. Littig, and W. Menz, Eds. Wiesbaden: VS Verlag für Sozialwissenschaften, 2002, pp. 33–70. doi: 10.1007/978-3-322-93270-9_2.
- [21] R. Buber and H. H. Holz Müller, Eds., *Qualitative Marktforschung*. Wiesbaden: Gabler, 2007. doi: 10.1007/978-3-8349-9258-1.
- [22] M. Saam, S. Viète, and S. Schiel, "Digitalisierung im Mittelstand: Status Quo, aktuelle Entwicklungen und Herausforderungen," *ZEW - Zentrum für Europäische Wirtschaftsforschung GmbH*, Mannheim, Forschungsprojekt im Auftrag der KfW Bankengruppe, 2016.
- [23] P. Trompisch, "Industrie 4.0 und die Zukunft der Arbeit," *E Elektrotechnik Informationstechnik*, vol. 134, no. 7, pp. 370–373, 2017, doi: 10.1007/s00502-017-0531-1.
- [24] T. L. Griffith, J. E. Sawyer, and M. A. Neale, "Virtualness and Knowledge in Teams: Managing the Love Triangle of Organizations, Individuals, and Information Technology," *MIS Q.*, vol. 27, no. 2, pp. 265–287, 2003, doi: 10.2307/30036531.
- [25] A. Luse, J. C. McElroy, A. M. Townsend, and S. DeMarie, "Personality and cognitive style as predictors of preference for working in virtual teams," *Comput. Hum. Behav.*, vol. 29, no. 4, pp. 1825–1832, 2013, doi: 10.1016/j.chb.2013.02.007.
- [26] A. Moeuf, R. Pellerin, S. Lamouri, S. Tamayo-Giraldo, and R. Barbaray, "The industrial management of SMEs in the era of Industry 4.0," *Int. J. Prod. Res.*, vol. 56, no. 3, pp. 1118–1136, 2018, doi: 10.1080/00207543.2017.1372647.
- [27] W. Bauer, S. Schlund, T. Hornung, and S. Schuler, "Digitalization of industrial value chains – a review and evaluation of existing use cases of Industry 4.0 in Germany," *LogForum*, vol. 14, no. 3, pp. 331–340, 2018, doi: 10.17270/J.LOG.2018.288.
- [28] O. Pakos, J. Walter, M. Rücker, and K.-I. Voigt, "The Leap into the New Normal in Creative Work: A Qualitative Study of the Impact of COVID-19 on Work Practices in Industrial Companies," *Eur. J. Bus. Manag.*, vol. 13, no. 10, 2021, doi: 10.7176/EJBM/13-10-01.
- [29] C. Riom and A. Valero, "The business response to Covid-19: The CEP-CBI survey on technology adoption," Centre for Economic Performance, London School of Economics and Political Science, London, 2020.