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The Growing Gap Between Pioneers and Laggards

**Digitalization, automation, and organizational change in the
wake of the COVID-19-crisis in Germany**

The Growing Gap Between Pioneers and Laggards*

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WEIZENBAUM INSTITUTE: The Weizenbaum Institute for the Networked Society – The German Internet Institute is a joint project funded by the Federal Ministry of Education and Research (BMBF). It conducts interdisciplinary and basic research on the changes in society caused by digitalisation and develops options for shaping politics, business and civil society.

Abstract

The COVID 19 crisis has had a massive impact on the world of work. Based on a standardized survey of 540 company sites and 34 qualitative case studies in six industries (automotive, chemicals, mechanical engineering, logistics, healthcare and financial services), this study examines how companies' digitalization and automation strategies have changed in the context of the pandemic. The analysis shows that the companies surveyed have by and large coped well with the crisis. However, an increasing polarization is becoming apparent. Digital pioneers intensified digitalization measures to a greater extent than those that were already behind in this respect before

the pandemic. The focus of digitalization during the pandemic was particularly on supporting processes in administration, human resources management and sales. Automation also primarily played a role in these fields and only a minority of respondents expected employment losses in the medium term. Another key finding of this study is the correlation between technical and organizational innovation. It can be observed that those companies that invested more heavily in technical digitalization processes were also more inclined to make organizational changes with regard to management styles, working hours and work organization.

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Table of Contents

1	Introduction	4
2	The Role of Digitalization And Automation In Overcoming the Crisis	6
3	An Increasing Polarization	7
4	Industry-Specific Fields of Digitalization	9
5	Mobile Working	11
6	Relationship Between Technical and Organizational Innovations	12
7	Conclusions	16
8	References	17

1 Introduction

The COVID-19-crisis is having a massive impact on the world of work. Within a short period of time, companies have had to transition some of their employees from in-office work to forms of mobile work and reorganize their processes accordingly. They have often had to adapt their product and distribution strategies because they could not reach customers through traditional channels and stores. They have also been forced to reorganize their supply chains, as some suppliers stopped or reduced production due to pandemic measures and transport routes were interrupted or disrupted in some cases.

While the crisis has undoubtedly had an immediate and short-term impact on companies and workers, it is unclear to what extent it has also affected company strategies beyond this. In particular, there is a question of whether it has led to a strengthening of digitalization (and automation) efforts. A number of studies have pointed to increases in the use of mobile working; it is enjoying growing acceptance and will certainly continue to shape the world of work in the future (Gronau & Haas, 2021). The research findings presented below also confirm this trend. At the same time, it is still unclear how companies have further developed or adapted their digitalization strategies during the pandemic as a whole (Butollo et al., 2021).

The state of digitalization in companies in Germany has been the subject of a nuanced but heated discussion. When we use the term digitalization, we take it to refer to the introduction of software systems for monitoring, controlling, and optimizing business and work processes. Digital applications can automate, network, assist and virtualize work processes (Hirsch-Kreinsen, 2020). We distinguish between digitalization and automation: Automation overlaps with digitalization but in a narrower sense refers to the use of technologies that can perform a specific task without human intervention (cf. Krzywdzinski, 2021).

While there are certainly a number of highly digitalized companies in Germany, studies have repeatedly concluded that many companies, especially small and medium-sized enterprises (SMEs), are not exploiting opportunities to digitalize processes (Falck et al., 2021). However, some studies have argued that catch-up digitalization processes have been underway in SMEs, especially during the COVID-19 crisis (e.g., Meffert et al., 2020). The aim of the present study is to systematically examine the extent to which the pandemic has resulted in a surge in digitalization that has closed the gap between pioneers and laggards.

Against this backdrop, the report analyses the digitalization strategies of companies during the COVID-19 pandemic. We are interested in the extent to which companies have used the crisis as a window of opportunity to drive digitalization and automation and in which fields of applications are particularly important.

Our focus is on the following questions:

1. What role did digitalization and automation measures play in companies' responses to the COVID-19 crisis?
2. In what areas is digitalization and automation being advanced by companies?
3. How do particular industries differ with regard to digitalization and automation processes?
4. How are technical innovations in the field of digitalization related to organizational change?

This policy brief provides an insight into the first results of the ongoing research project "Digitalization, automation and virtualization of the world of work in the wake of the COVID-19 crisis." The research combines a standardized sur-

vey of 540 company sites and qualitative 34 case studies in six industries: the automotive industry, the chemical industry, the mechanical and plant engineering industry, the logistics industry, the health industry, and the financial services industry. In this paper, we use the term “company” to refer to a legal entity that may include several sites, factories, or branches. By contrast, the word “company site” refers to a single company location. The term “survey” refers to the standardized questionnaire, while “case study” refers to the qualitative analysis. Our aim in selecting these industries was to cover both the manufacturing and service industries, and to choose industries in which effects of the COVID-19 crisis on digitalization and automation strategy would likely be evident (cf. Butollo et al., 2021).

The survey was based on a random sample that largely corresponded to the actual structure of the industries with regard to size and distribution across the federal states (taking into account the limited number of cases). The sample was composed as follows:

In the 34 qualitative case studies, our aim in the sampling process was to include different companies in terms of their size and position in the value chain of the respective industry (e.g., original equipment manufacturers (OEMs) and suppliers in the automotive industry) and, above all, to include large companies, which are just a small minority of the randomly sampled companies in the standardized survey. When selecting the companies, we therefore did not aim to achieve representativeness but sought to gain insights into differences and similarities in digitalization processes in different types of companies. The case studies were mostly based on interviews with management representatives (managers of digitalization projects, but also heads of HR or plant managers), works councils, or personnel councils, but we also interviewed industry and company experts. A total of 83 one to two-hour interviews were conducted. In contrast to the

company-site-focused standardized survey, the interviews mostly concerned entire companies, although the case studies also tried to exemplify the developments by focusing on selected sites. The case studies are composed as follows:

Table 1: Composition of the surveyed company sites (standardized survey)

	Share in %
Composition by industry	
Automotive industry	7,96% (<i>n</i> = 43)
Chemical industry	19,07% (<i>n</i> = 103)
Mechanical and plant engineering	17,41% (<i>n</i> = 94)
Logistics industry	17,78% (<i>n</i> = 96)
Health industry	18,89% (<i>n</i> = 102)
Financial services	18,89% (<i>n</i> = 102)
Composition by size	
1-49 employees	62,59% (<i>n</i> = 338)
50-249 employees	24,63% (<i>n</i> = 133)
More than 249 employees	12,78% (<i>n</i> = 69)

Table 2: Composition of the case-study companies

	Number of case studies
Composition by industry	
Automotive industry	6
Chemical industry	5
Mechanical and plant engineering	6
Logistics industry	6
Health industry	7
Financial services	4
Composition by size	
1-49 employees	-
50-249 employees	1
250-999 employees	4
1000 employees or more	29

In the following, we mainly address the initial findings of the survey and illustrate them with the help of selected case studies.

2 The Role of Digitalization And Automation In Overcoming the Crisis

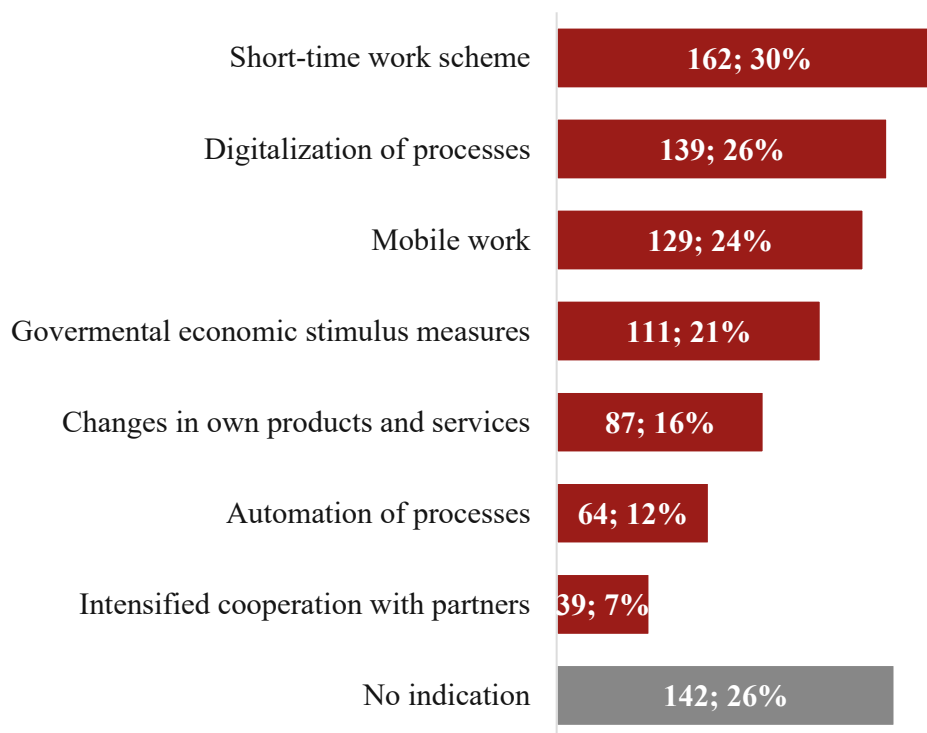
The present study shows that the surveyed businesses have fared well during the crisis on the whole. Only 23.1% of businesses stated that they had been hit hard or very hard economically by the pandemic. 30.4% said they had been somewhat affected, whereas 46% of the company sites were only affected a little or not at all. As a supplementary cluster analysis revealed, the size of sites did not play a decisive role in coping with the pandemic. Both small and large company sites were affected by the pandemic to a comparable extent and the share of company sites that coped well with the pandemic was very similar in both groups.

The findings of the survey were confirmed by the case studies. In contrast to companies and institutions in the retail, catering, and cultural industries, which faced massive consequences of the crisis, the case study companies in the industries examined by our study mostly coped well with the pandemic. However, there were certain differences between the industries we studied. In the manufacturing sector, the chemical industry came through the crisis without major declines in demand and had to cope with few or no interruptions in production. The automotive industry, on the other hand, experienced a massive drop in demand in 2020 due to the closure of dealerships, with disruptions in production continuing in the following year due to the increasing problems in supply chains in the semiconductor industry. The developments in the machinery and mechanical plant engineering industry were quite multifaceted: While companies in the woodworking machinery industry flourished due to the additional demand for furniture to set up home offices, machine tool and robot manufacturers, which were dependent on the automotive industry, had to cope with painful losses. In the service industries, the turbulence in some manufacturing industries affected logistics. Financial

services, in contrast, were hardly affected by the COVID-19 crisis. Finally, in the health industry, there were quite contradictory developments: On the one hand, the crisis brought many companies to the edge of their capacity, while on the other hand, the state stepped in with large support packages.

Consistent with the different development trends across industries, there were great differences in the measures adopted to tackle the crisis. The German federal government's short-time work scheme (*Kurzarbeit*, mentioned by 30% of the companies surveyed) proved to be the most important means of coping with the crisis across the entire sample. Remarkably, the second most important was the digitalization of processes followed by the introduction of mobile working – each of which ranked ahead of the government's economic stimulus measures. It is also worth noting that the automation of processes played a much smaller role than digitalization.

An examination of individual industries shows that the short-time work scheme was particularly relevant in the automotive, mechanical, and plant engineering industries as well as in parts of the contract logistics industry, which experienced significant slumps in demand and production. In each case, 44% of company sites in the respective industries reported that short-time work was important for them in surviving the pandemic. In thriving industries like the chemical industry, however, short-time work did not play a role. And in some instances – as in the case of one chemical company in our sample – companies explored ways to avoid availing of the short-time work scheme: for example, by reducing working hours at the beginning of the pandemic.

Figure 1: Which measures helped your company site to cope with the COVID-19 crisis?

Source: Krzywdzinski, Butollo, Bovenschulte, Nergler 2021. *N* = 540. Multiple responses possible.

Digitalization, on the other hand, was particularly important in the financial services industry. 56% of the surveyed businesses reported that the digitalization of processes was important for them to cope with the effects of the pandemic. In addition, this industry made very extensive use of mobile working (47% of company sites). In all other industries, slightly less than a third of the surveyed

company sites mentioned digitalization and mobile working as important means to get through the crisis. This is due to the nature of the work: Companies in the financial services industry were able to facilitate mobile working for much larger proportions of their workforces than, for example, companies in the manufacturing industries or the health industry.

3 An Increasing Polarization

With regard to digitalization in the COVID-19 crisis, an increasing polarization is becoming apparent: More digitalized businesses are increasingly leaving the less digitalized ones behind.

Regarding the level of digitalization, the survey sample is split. 15.9% of the businesses surveyed reported low levels of digitalization of work processes or

none at all. This contrasts with the 46.2% of businesses that reported high levels of digitalization, i.e. digitally networked systems in all departments and even comprehensive digital workflows interlinking departments. Between the two poles were the 38.4% of businesses that were only partially digitalized – i.e., they used individual digital solutions that were not yet comprehensively integrated with each other.

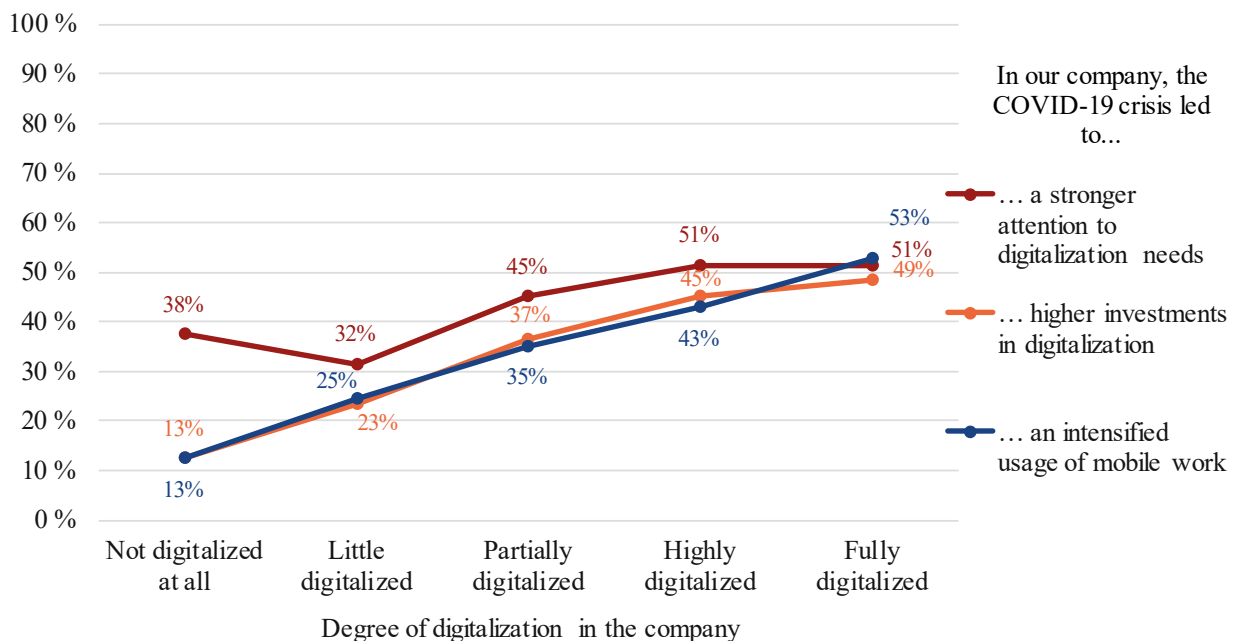
The survey shows that the level of digitalization was particularly high across the financial services industry (approx. 70% of the surveyed company sites were either largely or completely digitalized) and in the manufacturing industries of automotive, chemicals and mechanical engineering (approx. 50% of businesses were largely or completely digitalized). Digitalization levels were particularly low in the healthcare industry (approx. 43%) and the logistics industry (approx. 29%).

As Figure 2 shows, there was a clear correlation between a company's initial level of digitalization and its additional activities in this area during the crisis, in the form of management attention to digitalization,

investments in digitalization, and the use of mobile working during the crisis.

While only 13% of previously nondigitalized companies reported increased investment in digitalization during the COVID-19 crisis, 49% of the fully digitalized companies did. When it comes to the question of increased attention to digitalization needs, the gap was smaller: 38% of previously nondigitalized companies increased the attention they paid to digitalization needs. However, this had not yet been translated into increased investment at the time of the survey. Another striking, though not entirely surprising, finding was that digitalization and the accelerated implementation of mobile working were linked.

Figure 2: State of digitalization in company sites and changes in it during the COVID-19 crisis



Source: Krzywdzinski, Butollo, Bovenschulte, Nerger 2021. *N* = 540.

As Figure 3 shows, digitalization efforts were primarily directed towards administrative processes (23% of the companies reported new digital processes and 24% reported an acceleration of prepandemic digitalization measures), in-house training (23% and 22% respectively), and sales and distribution (17% and 23% respectively). These measures were mainly implemented by medium-sized companies (50 employees or more).

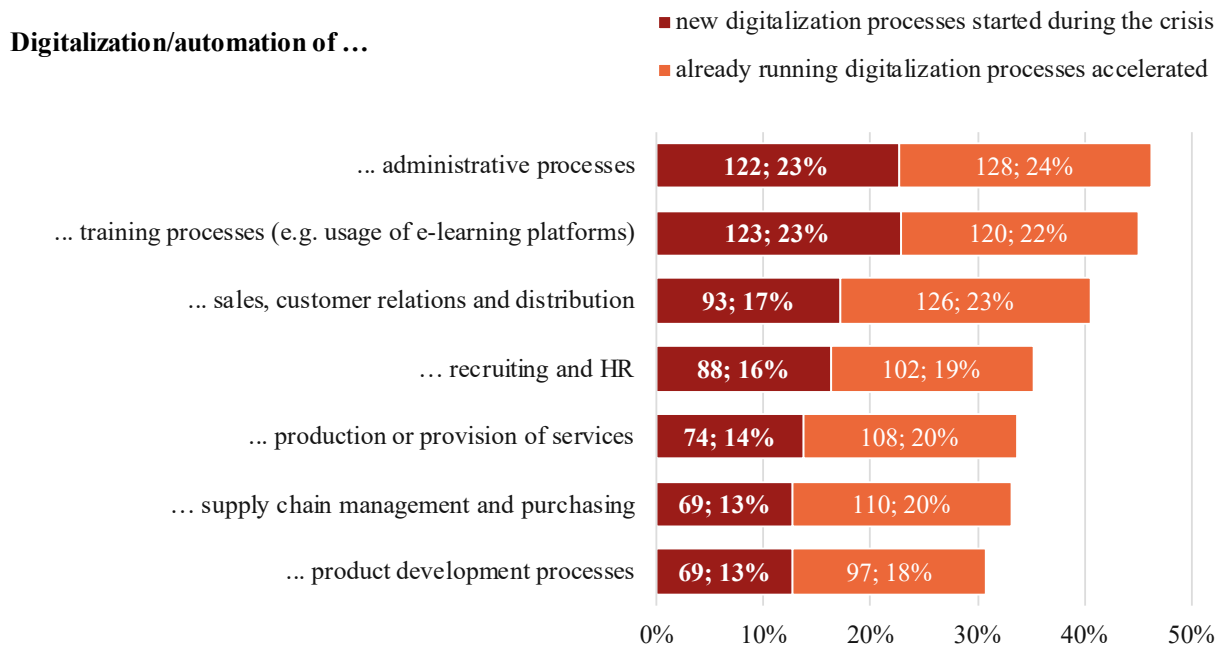
Some sectoral differences are worth mentioning. As expected, the automation or digitalization of supply chain management played a particularly important role in the chemicals industry (49% of the companies surveyed said they had introduced new digital processes or accelerated prepandemic digitalization) and automotive industry (41% reported introducing new digital processes or accelerating prepandemic ones). The automation of work

processes, by contrast, was most pronounced in the financial services industry (64% of the companies surveyed reported new digital processes or an acceleration of pre-pandemic digitalization). This put the financial services industry ahead of the automotive and chemical industries (39% each), mechanical engineering (32%), logistics (31%), and (as expected) the healthcare industry (19%).

The automation of work processes thus primarily concerned cognitive activities. This was also evident in our case studies: While there was hardly any push to more strongly automate production processes in the company sites studied, some

interviewees reported an accelerated automation of routine activities in administrative areas. Yet, despite automating simple processes, companies did not expect any reductions in employment. Only 23% of the interviewed companies expected that digitalization would have effects on employment within the next five years; 62% did not expect any changes in employment, and 15% could not make any statements on this. Those that did expect digitalization to have an impact on employment primarily mentioned potential increases in the proportion of employees with university degrees and vocational training certification and a decrease in semi-skilled employees.

Figure 3: Digitalization in company sites during the COVID-19-crisis by business processes



Source: Krzywdzinski, Butollo, Bovenschulte, Nerger 2021. *N* = 540.

4 Industry-Specific Fields of Digitalization

In addition to these general areas of digitalization that applied to all companies, we also asked about industry-specific fields of application in the survey (cf. Figure 4). Pronounced differences emerged here, which we illustrate with examples.

In the *financial services* industry, many businesses reported increased efforts in the area of automated processing. This referred to activities such as invoice submission or the reconciliation of data. Although many businesses reported making

investments in this area in the survey, the findings of our qualitative case studies suggest that many such automation processes are still in an initial phase. Several of the company representatives we interviewed reported a rather slow process of digitalization and automation. According to them, substantial progress has been made in the digitalization and automation of customer contacts but relatively little in terms of back-office processes. For example, one bank that we studied recorded a significant increase in virtual customer meetings and online banking as a result of the pandemic. In the future, it therefore planned to expand virtual consulting centers, where employees could respond to customer concerns and offer consultation by telephone and virtually, while many physical branches would remain closed. However, there are contrasting cases where digitalization and automation have been slow.

With regard to the *automotive industry*, the standardized survey showed a particular emphasis on the accelerated introduction of assistance systems. Assistance systems are software that guides and controls workers, for instance, in assembly or logistics, but also even in problem solving (especially in maintenance). In the qualitative case studies, however, the topic of “assistance systems” did not stand out. Here, digitalization encompassed all areas of the product (connected car) and the processes in the companies – at the same time, automotive industry personnel stressed particularly strongly that these processes had already begun before the COVID-19 crisis and that the pandemic had only given a limited additional push.

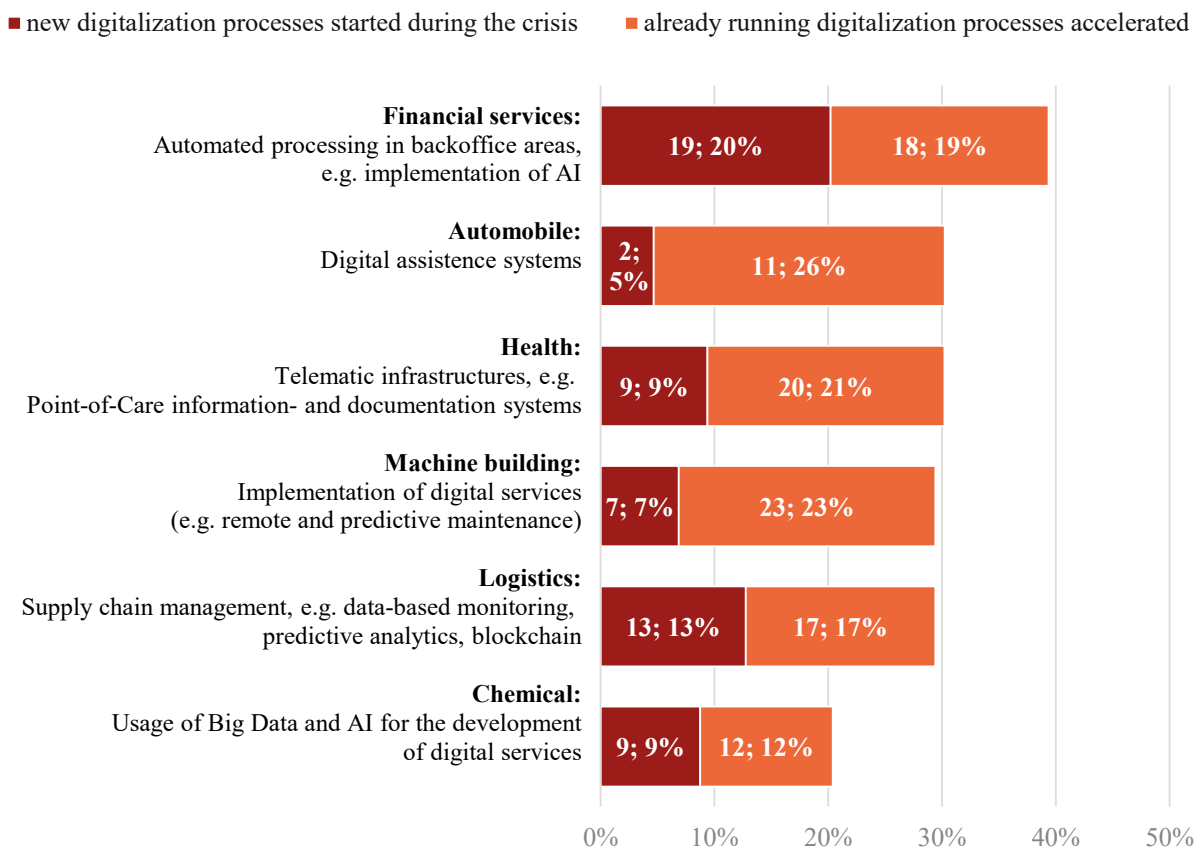
In the *healthcare industry*, the introduction of telemetric infrastructures played a particularly important role. In this industry, digitalization had been particularly slow before the pandemic, due to both a lack of resources and exceptionally complex regulation. The demand for a switch from paper-based to digital documentation processes in the sense of a “health care data highway” for secure data exchange had been around for a long

time, but it had not, or only inconsistently, been put into practice. During the pandemic, the importance of fast, digital, and uniform information availability increased massively, not only within hospitals (e.g., for bed occupancy management), but also between facilities and different actors in the health care system. While some hospitals were already well advanced in this respect, others lagged behind, and nursing facilities in particular had been “left behind” for a long time. The pandemic acted as an accelerator. With the Hospital Future Act (*Krankenhauszukunftsgesetz* or KHZG for short), the government made large investments available for digitalization in the health industry for the first time.

In *mechanical engineering*, the main focus was on accelerating the introduction of digital services. Digital services include remote maintenance and preventive maintenance of plants. Based on digitally transmitted data, technicians can correct any malfunction. By employing these digital services, the companies could adapt to the limited possibilities for sending maintenance staff away from their home base, especially to foreign locations, due to the pandemic. Due to contact and travel restrictions, the virtualization of the commissioning processes for new plants also increased. In remote commissioning, the plants are filmed during the first complete installation at the producer’s plant. The customers can follow the virtual transmission, which also allows them to show details or demonstrate test runs. In another case, a producer of less complex equipment introduced a video platform guiding customers through the installation.

Some companies in the *logistics industry* reported increased efforts to network and control supply chains. This refers to two distinct entities: first, to monitoring and control software that enables early warnings and a more flexible response to supply chain disruptions, and, second, to solutions for the flexible coordination of the supply chain via transaction platforms.

Figure 4: Industry-specific fields of application of digitalization and automation during the COVID-19 pandemic



Source: Krzywdzinski, Butollo, Bovenschulte, Nerger 2021. $N = 540$.

The *chemical industry* was the least active. Here, mobile working was the main phenomenon that experienced a boost from the COVID-19 pandemic. There was not much of a digitalization push in production, because many technologies, such as predictive maintenance or intelligent logistics and goods ordering, had already been introduced

before the pandemic. However, the importance of big data and AI was highlighted in many interviews in the case studies. Interviewees regarded the potential of these technologies as high. In the case studies, the advanced level of automation and digitalization throughout the industry was repeatedly emphasized.

5 Mobile Working

In all our case studies, mobile working was a focus of digitalization measures during the pandemic and the issue was at the core of new negotiation processes between works councils and management. Some pioneering companies already had bargaining agreements in place before the COVID-19 pan-

demic; for many others, such agreements had to be concluded (Mierich, 2020). Key areas of negotiation were the recording of working time and performance management, equipment in employees' home offices, the amount of working time from home, and also the design and distribution of office

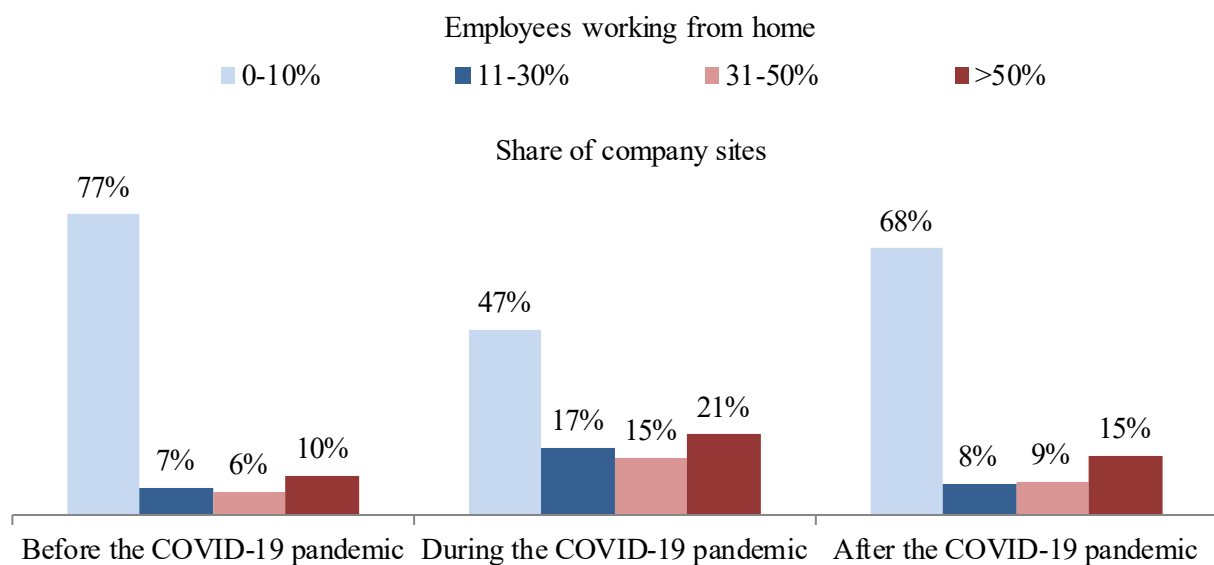
space in the postpandemic period. These negotiations were fraught with great uncertainty on the part of both the management and the works councils.

In the standardized survey, we asked about the extent of mobile working before, during, and after the COVID-19 pandemic (Figure 5). Our sample reflects a specific industry selection, so the statements on the extent of mobile work are not generalizable. What is noteworthy, however, is that the surveyed companies clearly expected prepandemic in-office working to return in some form after the end of the pandemic: They expected a higher proportion

of employees to work remotely after the pandemic than before but did not think it will be anywhere near the level during the pandemic period itself.

However, our qualitative case studies highlight that despite this expected “normalization,” the rules of working will not be the same as before the pandemic. In many of our case study companies, bargaining agreements now provide more comprehensive options for mobile working than before the pandemic. In addition, a number of our case study companies are beginning to recalibrate the amount and use of office space.

Figure 5: Proportions of employees working from home before, during, and after the COVID-19 pandemic



Source: Krzywdzinski, Butollo, Bovenschulte, Nerger 2021. *N* = 441 of the company sites surveyed. 99 sites could not provide any information.

6 Relationship Between Technical and Organizational Innovations

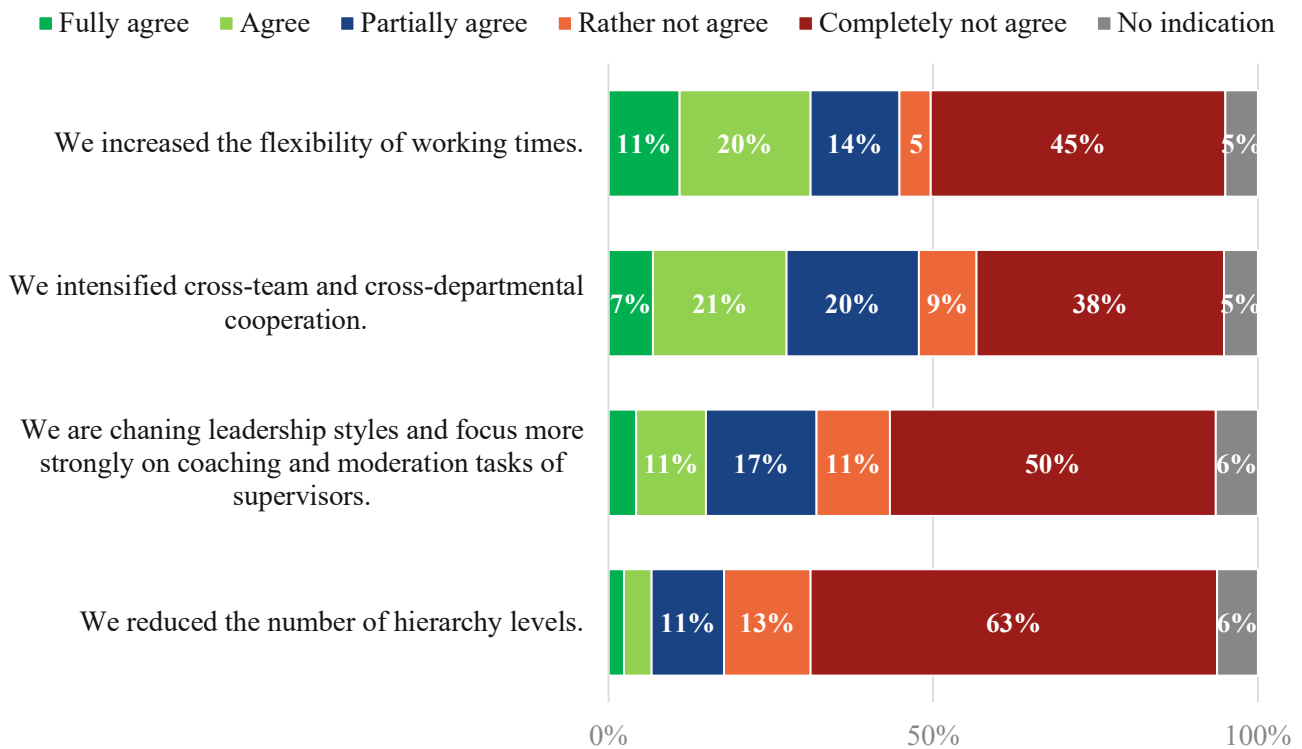
The analysis clearly shows that there is a close relationship between technical and organizational innovations, a well-known phenomenon in research. Organizations are socio-technical systems – that is, they are configurations of technical systems (for data processing, transport, or manufacturing) and

work systems (the relationships between people in work processes and organizational processes and structures) (Ulich, 1997). The added value of innovations can only be realized when the technical and social systems are coordinated.

The survey revealed that a group of companies invested in organizational innovation during the pandemic. As Figure 6 shows, 45% of the company sites surveyed at least partially revised working time arrangements to increase working time flexibility. 48% at least partially invested in measures to strengthen cross-team and cross-divisional collaboration. There were also changes in leadership styles and hierarchy that were somewhat less pronounced but still relevant; 32%

of the company sites surveyed had (at least partially) started to initiate a change in leadership styles via coaching and facilitation programs. This involved less hierarchical control (including reductions in so-called “presenteeism”) in favor of more coaching-style leadership. At least 17% of the company sites had even started to flatten their hierarchies; this happened regardless of the industry but tended to be less evident in smaller companies (up to 50 employees).

Figure 6: How strongly did your company site’s organizational practices change during the COVID-19 pandemic?

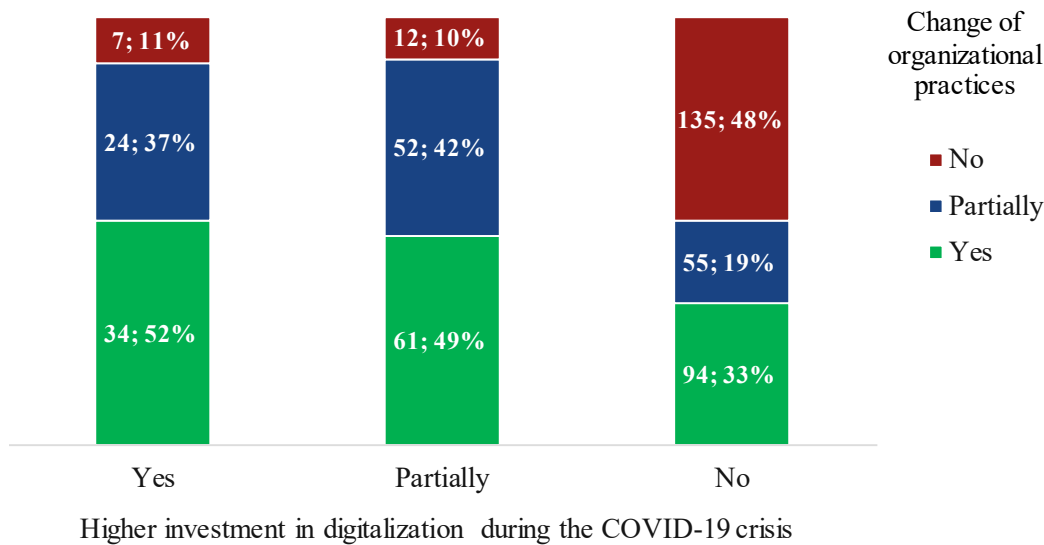


Source: Krzywdzinski, Butollo, Bovenschulte, Nergler 2021. N = 540.

Organizational changes had in particular been made by companies that invested in digitalization, as Figure 7 shows. Among the company sites that had at least partially increased their digitalization investments during the pandemic, about 50% had made clear organizational changes and another 40% had partially introduced innovations; only 11% reported no organizational changes at all. This is in clear and statistically significant contrast to company sites that did not make any digitalization investments during the pandemic. Among the latter, 48% had introduced

no organizational changes. Strikingly, about half of these company sites were very small, with between 1 and 9 employees; 80% had fewer than 50 employees.

As far as sectoral differences are concerned, companies in financial services were particularly active in implementing organizational changes, according to the survey. They had notably intensified self-organized work and also increased working time flexibility. This was probably related to the high prevalence of mobile working in this industry, as mentioned above.

Figure 7: Relationship between investment in digitalization and organizational change

Source: Krzywdzinski, Butollo, Bovenschulte, Nerger 2021. $N = 540$.

However, there were also examples of organizational innovation in other industries. One example of an innovation-oriented response to the challenges of the COVID-19-crisis was the establishment of a “Smart Work Team” in a case study company in the automotive industry. Internal analyses of the company showed that the introduction of mobile working across the board turned out to be positive overall and resulted in consistent or even increased performance. A representative of the HR department commented: *“And with this insight, the company decided, let’s derive something from this experience which we will implement in the future across the board and globally in the way we want work to be done.”*

The “Smart Work Team” analyzes experiences with mobile work in different areas and locations. They focus on the design of the employees’ tasks, the team organization, the organization of working time, and the arrangement of office space. The Smart Work Team then moderates discussions between the supervisors and the teams about problems and possible solutions. Furthermore, the team deals with questions of leadership culture. At present, it is trying to promote a shift away from a controlling leadership style based on the on-site presence of workers towards a leadership style based on the results of their

work. In the long term, the team will also deal with office design, which is about to change in the wake of increased mobile working and desk sharing and reductions in the number of individual workstations.

In addition to demonstrating the importance of organizational changes, our survey also shows that the COVID-19 pandemic has become a trigger for changes in education and training. In this respect, the measures taken during the pandemic also correlate with investments in digitalization. Companies invested most in training in the area of self-organized working (46% of the company sites surveyed invested at least partially here) and IT knowledge (39% of the company sites). While the investments in increasing IT training are self-explanatory, the importance of self-organized working is particularly interesting. It reinforces our thesis that technical investments in digitalization during the COVID-19 crisis have been accompanied by organizational innovations. Not least in the context of mobile working, the demands concerning self-management among employees and teams have increased regarding both working time organization and the independent planning of work processes. Where employees are not sufficiently supported, stress symptoms increase, especially since mobile working is also accompanied by less social interaction.

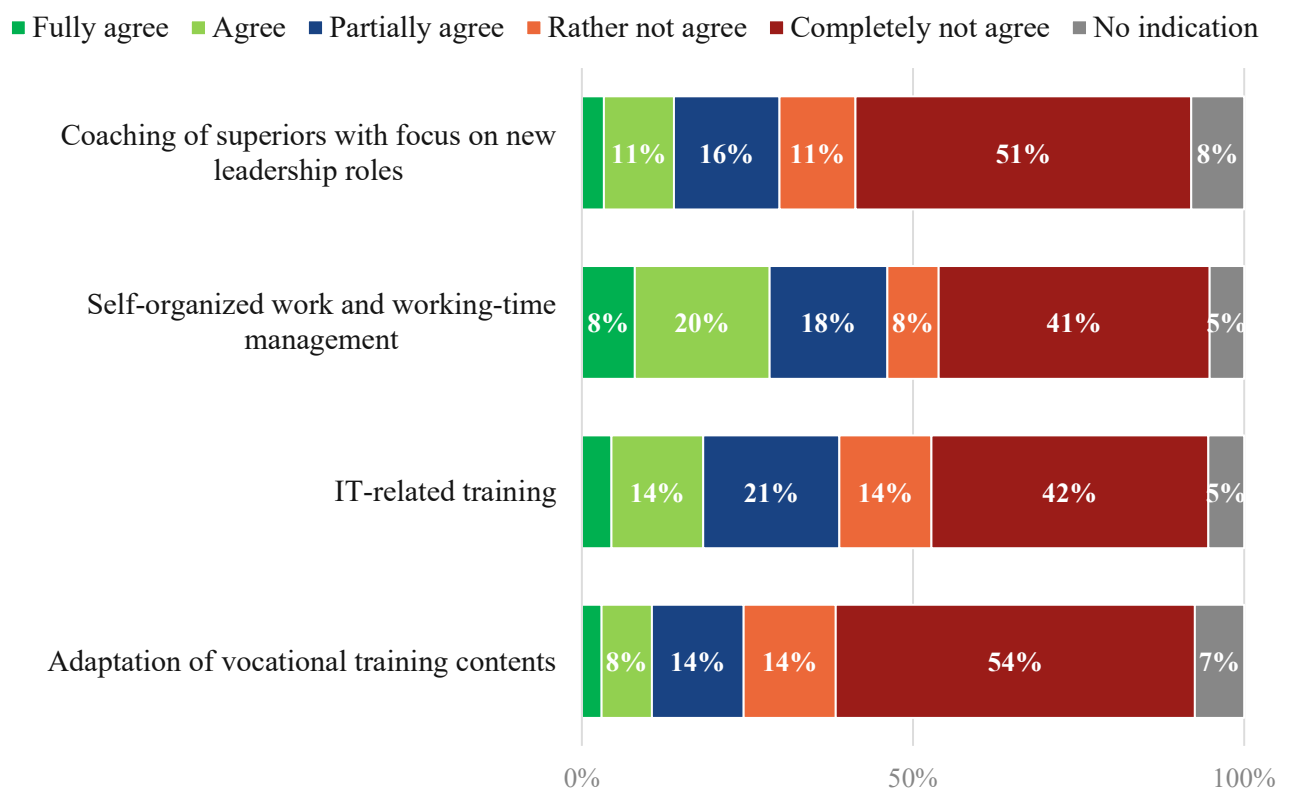
A somewhat smaller proportion of 30% of the companies surveyed had increased the number of training courses with the aim of changing leadership styles and enabling leadership from a distance under the conditions of mobile working. Changes in training content played the smallest role, although 25% of the companies surveyed nevertheless reported that they made adjustments in this area.

Our case studies show that the unique context of the pandemic partly facilitated access to training

measures. The massive expansion of e-learning opportunities, already shown in Figure 3, increased workers' flexibility in choosing the amount and duration of training they wanted. The works council of one care facility reported:

So, for example, I see it as positive that the staff can do this online training. [...] [If] they are on late shift, they can do it in the morning when the children are perhaps in kindergarten and at school. Or in the evening, when the husband is at home or the children are in bed. Anyway, there is a bit more freedom.

Figure 8: Measures taken by the surveyed companies in the field of education and training during the COVID-19 pandemic



Source: Krzywdzinski, Butollo, Bovenschulte, Nergler 2021. *N* = 540.

To our surprise, organizational measures, ranging from a geographical relocation of processes to the closure of production sites, played a relatively marginal role for the companies we surveyed (Figure 9). There were hardly any dramatic effects in the companies we studied. Less than 10% of the respondents reported plant closures, relocations of

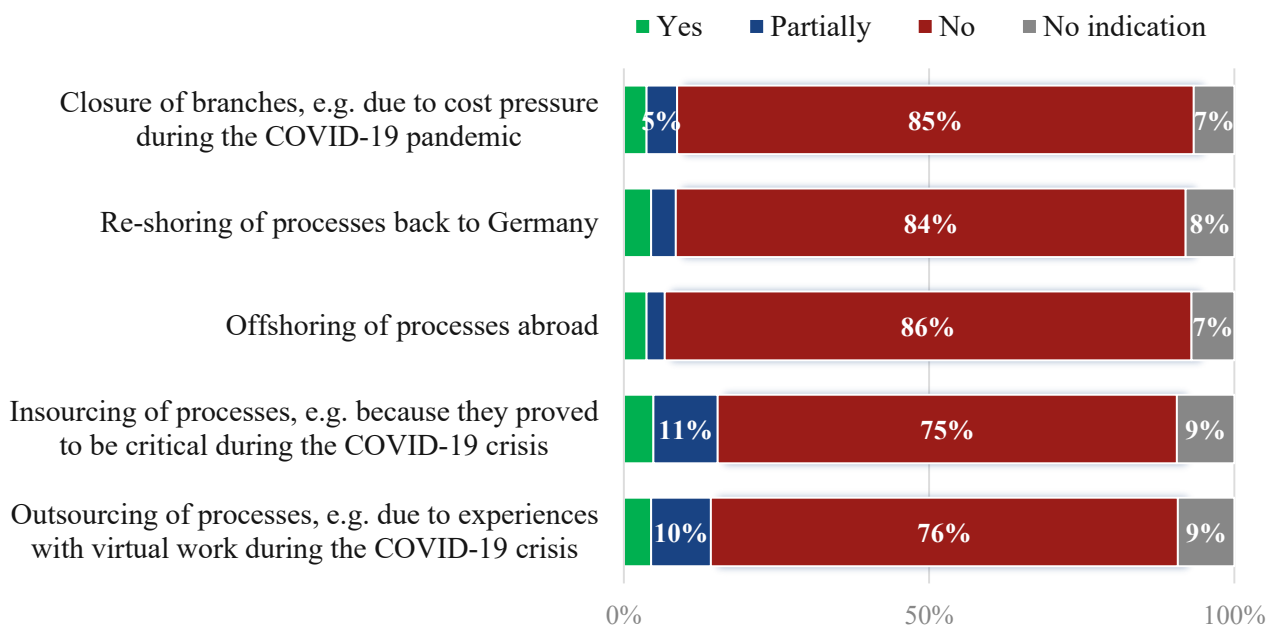
production abroad, or the reshoring of production to the domestic market. At the same time, relocations abroad and relocations back to the domestic market were more or less balanced.

This was confirmed by our case studies. We only found plans for relocation in a few exceptional

cases and only in the automotive industry. Relocations to low-wage countries (especially in Central Eastern Europe) have played an important role in the automotive industry for a long time (Schwarz-Kocher et al., 2019). During the COVID-19 crisis, automotive suppliers, who were faced with severe cost pressure, were especially active in pushing relocations. In addition,

the transition from the internal combustion engine to electric vehicles, which was accelerated by government subsidies during the COVID-19 pandemic (i.e., the purchase premium for electric vehicles), played an important role for the automotive industry. In this context, some automotive suppliers relocated the production of discontinued components for combustion engines.

Figure 9: Restructuring measures of company sites during the COVID-19 pandemic



Source: Krzywdzinski, Butollo, Bovenschulte, Nerger 2021. $N = 540$.

Insourcing and outsourcing were somewhat more frequent, with both developments balancing each other out. In our survey, insourcing was mentioned

particularly by mechanical engineering and financial services companies. Outsourcing was especially common among financial services companies.

7 Conclusions

The study leads to a number of conclusions. First, it shows that the surveyed companies have mostly coped well with the crisis. In economic terms, they have performed relatively well and there are hardly any firms whose existence was genuinely threatened. Against this background, and evaluating the measures that helped the companies during the crisis, we

find that the digitalization of processes and the introduction of mobile work played an important role. However, an increasing polarization is evident here. Digital pioneers intensified digitalization measures to a greater extent during the pandemic than those who were already behind in this respect prior to the pandemic. Thus, we observe a further widening of

the gap rather than a catch-up process. This will have increasingly disadvantageous consequences for the laggards in the future.

Digitalization efforts during the pandemic were particularly directed to cognitive activities and processes, for example, in administration, human resource management, and sales. While this was the case across industries, there were also particular industry focuses depending on the business models – such as the financial services industry’s emphasis on automated processing of data or the mechanical engineering industry’s focus on digital solutions for remote maintenance and virtual commissioning. Automation played a role in fields of cognitive work and only a minority of respondents expected employment consequences caused by digitalization in the medium term.

A central finding of this study also relates to the connection between technical and organizational innovation. Companies that invested more in technical digitalization processes were also more inclined to make organizational changes. In addition to making working time arrangements more

flexible, this also included adapting management concepts and management styles and expanding training in the areas of employee self-organization and new leadership concepts. The great relevance of organizational changes for successfully overcoming the COVID-19 crisis confirms previous findings from innovation research studies, which identify the ability to adapt to changing conditions as an essential prerequisite for entrepreneurial success (cf. Apt et al., 2016).

Prototypically, this characteristic is most pronounced in highly digitalized companies (with predominantly knowledge-intensive/high-value services, agile work structures and strong networking with external actors) (Bovenschulte et al., 2018). Companies that successfully combine organizational and technical innovations will be more resilient and crisis-resistant in the long term. A strong capability in terms of organizational-technical innovation can thus help companies to overcome crises – like the COVID-19 crisis – by prompting increased resilience. Such crises may even lead companies to recognize the potential in crises (Busch-Heizmann et al., 2021).

8 References

- Alexander, M., Meissner, F., & Kirschstein, T. (2021, Dezember 15). *Steering through the semiconductor crisis*. Roland Berger. <https://www.rolandberger.com/en/Insights/Publications/Steering-through-the-semiconductor-crisis.html>
- Apt, W., Bovenschulte, M., Hartmann, E. A., & Wischmann, S. (2016). *Foresight-Studie „Digitale Arbeitswelt“* (Forschungsbericht 463). Bundesministeriums für Arbeit und Soziales.
- Bovenschulte, M., Priesack, K., & Apt, W. (2018). *Die digitale Transformation von Unternehmen* (iit perspektive Nr. 44). Institut für Innovation und Technik.
- Busch-Heizmann, A., Shajek, A., Brandt, A., Nerger, M., & Peters, R. (2021). *Fallstudien zu den Auswirkungen der Corona-Krise auf betriebliche Transformationsprozesse* (Forschungsbericht 580/3). Bundesministeriums für Arbeit und Soziales.
- Butollo, F., Feuerstein, P., & Krzywdzinski, M. (2021). Was zeichnet die digitale Transformation der Arbeitswelt aus? Ein Deutungsangebot jenseits von Großtheorien und disparater Empirie. *Arbeits- und Industriesoziologische Studien*, 14(2), 27–44.

- Falck, O., Czernich, N., Pfaffl, C., Ruthardt, F., & Wölfl, A. (2021). *Benchmarking Digitalisierung in Deutschland*. ifo Institut.
- Gronau, P., & Haas, G.-C. (2021, Juni). *Homeoffice in der Corona-Krise: Vorbehalte haben abgenommen*. IAB-Forum. <https://www.iab-forum.de/homeoffice-in-der-corona-krise-vorbehalte-haben-abgenommen/>
- Hirsch-Kreinsen, H. (2020). *Digitale Transformation der Arbeit: Entwicklungstrends und Gestaltungsansätze*. Verlag W. Kohlhammer.
- Krzywdzinski, M. (2021). Automation, Digitalization, and Changes in Occupational Structures in the Automobile Industry in Germany, Japan, and the United States. A Brief History from the Early 1990s until 2018. *Industrial and Corporate Change*, 30(3), 499-535.
- Krzywdzinski, M., Butollo, F., Bovenschulte, M., & Nerger, M. (2021). *Covid-19 und Digitalisierung in Betrieben* [unveröffentlichter Datensatz]. Weizenbaum-Institut für die vernetzte Gesellschaft.
- Meffert, J., Mohr, N., & Richter, G. (2021). *How the German Mittelstand is mastering the COVID-19 crisis*. New York: McKinsey & Company.
- Mierich, S. (2020). *Orts- und zeitflexibles Arbeiten* (Study Nr. 446). Hans-Böckler-Stiftung.
- Schwarz-Kocher, M., Krzywdzinski, M., & Korflür, I. (2019). *Standortperspektiven in der Automobilzulieferindustrie. Die Situation in Deutschland und Mitteleuropa unter dem Druck veränderter globaler Wertschöpfungsstrukturen* (Study Nr. 409). Hans-Böckler-Stiftung.
- Ulich, E. (1997). Mensch, Technik, Organisation: ein europäisches Produktionskonzept. In O. Strohm & E. Ulich (Hrsg.), *Unternehmen arbeitspsychologisch bewerten: ein Mehrebenen-Ansatz unter besonderer Berücksichtigung von Mensch, Technik und Organisation* (S. 5-17). vdf Hochschulverlag.