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# Impacts vs Implications: Rushed Technology Adoption in Small and Medium Enterprises due to Covid-19 Pandemic

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**Abstract.** The surge of digitalization during the pandemic has long-lasting impacts on business organizations: small and medium enterprises (SMEs) rushed towards digitalization to continue operations with the ever-changing local and international implications of the pandemic. This caused these businesses to adopt digital technologies for work and interconnection, often overlooking the necessary use innovations and skills required for long-term usage, with the aim of becoming agile and resilient against the pandemic. To understand the long-term impacts and implications of rushed technology adoption in SMEs, we used case-oriented qualitative comparative analysis (QCA) and content analysis over a collection of thirty semi-structured interviews with SMEs based in Germany. The preliminary findings of our long-term study reveal the haphazard and

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impulsive decision making in SMEs, rushing towards digitalization to be resilient and agile to the changing work conditions which led to a high demand for technology-related skillset in employees. Through this study we contribute to the understanding of technology adoption, use and appropriation for work in SMEs elaborating the necessity for long-term processual nature which is similar to notion of infrastructuring.

## Introduction

The pandemic crisis (2019-2022) exposed many vulnerabilities in organizational infrastructures, especially exposing the small and medium enterprises (SMEs) with limited resilience and inability to stay operational due to inadequate/insufficient technology, skills and usage (Alaqra & Kitkowska, 2021; Priyono et al., 2020). One of the reasons SMEs were unprepared for such an emerging situation was their unwillingness to recognize and rectify gaps in inter and intra-organizational digital connectivity (Chang et al., 2010; Lecerf & Omrani, 2020). It reaffirmed the perception about SMEs being fragile against emergent situations as they do not hold the resources and technical systems often equated with resilience capabilities (Sullivan-Taylor & Branicki, 2011). Technology adoption as means of interconnectivity has positive impacts on business operations, directly and indirectly, and has immense potential to support resilience in organizations making them agile towards changes providing alternate mediums for working (Ollo-López & Aramendía-Muneta, 2012). Interconnectedness via the usage of information and communication technologies also supports articulation work and collaboration for crisis in business organizations (Pipek et al., 2014; Robertson & Wagner, 2015; Tarutė & Gatautis, 2014). Many empirical investigations have been vested in grounding the theoretical foundations, usability, use cases and design implications of individual digital technologies (Ciolfi & Lockley, 2018; Dabbish & Kraut, 2006; Koch et al., 2015; Lewkowicz & Liron, 2019; Nauwerck & Forssell, 2018; Schmidt, 2011). Still, the implications and impacts of rushed digitalization for resilience, especially in the context of SMEs, are not explored expansively and deserves further attention from the computer-supported cooperative work (CSCW) community (Hespanhol, 2017; Ludwig, Kotthaus, et al., 2018; Pipek et al., 2014).

Resilience focused organizations are both proactive and agile where the focus is on both developing long-term plans for predicted disruptions, but at the same time ensuring that the right skills and resources are in place to deal with the unexpected (Burnard et al., 2018). The usage and adoption of digital technologies have become a pinnacle of interest in many research communities since the advent of the enduring pandemic, discussing the voluntary and involuntary rush of digitalization in the business world (Akpan et al., 2020; Kimuli et al., 2021; Priyono et al., 2020; Thorndahl & Frandsen, 2020). Rushed technology adoption means that a company has discovered the lack of digital technologies to continue operations and is rushing to adopt digital technologies for interconnection as a means of survival in times of

crisis (Faraj et al., 2021). The impacts of technology adoption during the pandemic will also continue in the post-pandemic period (Fletcher & Griffiths, 2020; Sein, 2020). A focus in SMEs is timely and relevant given how these organizations have massively been contributing to the economy – as is the case of Germany, SMEs are considered crucial as they incarnate scope for innovation, job creation, and integration of local communities (European Union, 2015). SMEs are also distinct due to their elementary organizational structures, constrained financial capital, centralized decision making, organizational customs and cultures, top-down organizational policies, and the high reliability of employees’ skills for business operations (Blatz et al., 2018; Tarutè & Gatautis, 2014). These peculiarities and expertise in their respective areas of operation tend to keep them in their ‘comfort zones’ and hence sometimes hinder the adoption of digital technologies (Bos et al., 2002). In this contribution, we draw attention to organizational resilience and its relations with the adoption and usage of digital technologies for interconnection and cooperative work. In so doing, we try to answer the following research question: *How did the pandemic influence technology adoption in SMEs, and what are the implications and long-term impacts on technology usage as a result?*

To this objective, we conducted thirty semi-structured interviews in SMEs to assess the impact of the crisis and the inclination or aversion to digital technologies. We analyzed the interviews using case-oriented qualitative comparative analysis (QCA) and content analysis to identify the trends in technology adoption during the pandemic. Direct and calibrated quantification of qualitative data was done for case-based comparison using QCA to unveil the extended dimension of technology adoption during the crisis and expected usage after crisis. The following sections will first illustrate the related work on technology adoption and resilience from multidisciplinary perspectives. Then we will discuss the applied research methods for data collection and analysis and present our results, and finally, discuss the contribution based on the results for CSCW research.

## Related Work

### Technology Adoption and Usage for Resilience

The concept of organizational resilience claims it to be the fundamental ability of an organization to adjust its functioning before, during, or after changes in the environment to successfully (1) manage both expected and unexpected disturbances, and (2) exploit both expected and unexpected opportunities (Burnard & Bhamra, 2011). Resilience is an acquired trait for an organization that becomes an intrinsic property when the adopted resources can reduce vulnerability and improve the agility and speed of the organization to manage crises effectively (Bhamra et al., 2011; Burnard et al., 2018). Resilience through technology adoption

and usage is considered to ensure agile work practices, as the ability to repair old practices and develop new practices when old ones are no longer possible (Junker et al., 2021; Mark & Semaan, 2008). This also holds for digital technologies in SMEs as means to provide infrastructure for interconnectivity between different faculties of a business organization with capabilities to support operations, work and collaboration in normality and crisis (Ludwig, Kotthaus, et al., 2018; Mark et al., 2009; Mark & Semaan, 2008; Pipek et al., 2014; Semaan et al., 2016; Syed et al., 2021).

The pandemic has acted as a natural breaching experiment that challenged the taken-for-granted expectations about digitalization and revealed the issues with digital infrastructures, the persistence of the analog in digitalization, and the brittleness of unchecked digitalization in business organizations (Faraj et al., 2021). The notion of infrastructure in CSCW and related fields is defined by the entirety of devices, tools, technologies, standards, conventions, and protocols on which the individual worker or the collective rely to carry out the tasks and achieve the goals assigned to them (Pipek & Wulf, 2009). Infrastructures emerge because of long term and processual endeavors embedded in and learnt as practices and are invisible only surfacing or crystalizing upon breakdown (Star & Bowker, 2018; Star & Ruhleder, 1994).

To cope with the pandemic, the world retreated towards digital work practices and building technology infrastructures rapidly that led to rushed technology adoption in businesses, enforced work from home, and shifting technological affordances resulting in positive and negative effects on work in general and collaborative work in particular (Cho et al., 2020; Waizenegger et al., 2020). However, organizational resilience through the adoption of digital technologies cannot be established without interconnecting all focus areas of business as a measure of strategic priority. To their disadvantage, SMEs were found to be unprepared to accept the evolving digitalization trends even before the pandemic (Burnard et al., 2018; Koch et al., 2015; Manochehri et al., 2012; Tarutė & Gatautis, 2014), hence resulting in non-processual technology adoption, rushed digitalization and infrastructural breakdowns (Alaqra & Kitkowska, 2021; Kimuli et al., 2021).

## Technology Adoption and Usage in SMEs

Ackerman et al., (Ackerman et al., 2007) argue that for users to adopt technology, they must both understand its capabilities and have scaffolding mechanisms for collectively discovering, structuring, iterating, and enacting practices that enable the technology to become a resource. For SMEs, factors like skillset, innovativeness, organizational support, business strategy, leadership, as well as company culture and orientation towards technology adoption also hold relevance (Acar et al., 2005; Blatz et al., 2018). Whereas limited funds, lack of skills, expensive technological transition, and inadequate infrastructure are the key

barriers to adopting digital technologies (Ongori, 2009; Ongori & Migiro, 2010). Due to lean administrative hierarchies and centralized decision making, the decision for technology adoption is mostly an executive or a management driven endeavor in SMEs (Aidah et al., 2017; Priyono et al., 2020).

Digital technologies for interconnection spans throughout an organization; they further specify the abilities of an organization, including collaboration among employees, between departments and with suppliers and customers (Nguyen, 2009; Ongori, 2009). The usage of digital technologies of interconnection makes SMEs adaptive and flexible when dealing with crises and are effective means of realizing the coping strategies necessary to build organizational resilience (Etemad, 2020; Falkner & Hiebl, 2015; Priyono et al., 2020). The interview study employed for this research does not examine the adoption of individual digital technologies; instead, we orchestrate the results from a descriptive and qualitative lens by considering the digital technologies for interconnection as a broad category for SMEs. It provides a critical account for multidisciplinary research by analyzing the impacts of rushed technology adoption in SMEs and implications for long-term usage and organizational resilience.

## Methods of Data Collection and Analysis

The interview study is based on thirty semi-structured interviews conducted in local SMEs based in Germany's second biggest industrial region during the years 2021-23. The interview topics were derived from former studies of our team and literature and covered: past experiences with crisis, their crisis management and resilience strategies, handling of the pandemic so far, experiences with technology adoption for staying operational in business, and short- and long-term impacts on policies and usage of digital technologies. Interview participants included representative from companies (SMEs) from a wide range of branches, as diverse as bakeries, material production companies, chemical manufacturers, textile etc., and services like procurement, training, logistics, wholesale, distribution etc. The interview partners were primarily in executive or management positions because technology adoption is typically a top-down initiative in such firms, as discussed in the related work. All interviews were conducted via digital media like Zoom or Skype in single sessions (lasting forty-five to sixty minutes in duration) and were transcribed later for analysis. Informed consent was obtained before the interviews, formally, which is also part of the trust-building process with the participants – please refer to Table II for a complete list of the participants and metadata.

The data collected via interviews were analyzed using qualitative analysis methods in two stages: Firstly, we employed content analysis (Mayring, 2022), which involved the classical process of coding the transcripts and determining the strength of prominent codes in the data. The most prominent codes identified during the analysis include crisis definition, long and short-term strategies against the

pandemic, usage of technologies before pandemic, technology adoption during pandemic, and effects of technology adoption. The authors collaborated in group data analysis sessions consisting of two to three researchers from multi-disciplinary backgrounds, which contributed to validating interpretations, analyses and gaining intersubjectivity of the interpretations. MaxQDA© was used for the qualitative data analysis, and codes were developed inductively from data material through active listening and reading the transcripts. The coded data has ultimately been summarized in the key findings that are presented across the results section.

While coding for content analysis, we also employed direct quantifiable measures and calibration techniques following the qualitative comparative analysis (QCA) method by Ragin (Ragin, 1989). This allowed us to create dimensions for case-oriented analysis. Quantification via calibration in QCA complemented the content analysis technique, enabling the examination of cross-case patterns across different SMEs. This approach provided us with a form of meta-analysis, unveiling underlying implications and impacts that transcend individual case specificity. The following section illustrates both parts of the study with further methodological explanations and results.

## Analysis and Findings

In the following sections, we elaborate on the findings from both parts of our study, namely the results from the interview study using case-oriented QCA and content analysis. Findings from both analyses are analytically developed with the assistance of the literature and through interpretation of the results.

### Case-Oriented Qualitative Comparative Analysis of SMEs

To enrich our findings from the more descriptive and interpretative content analysis and to add a meta layer of analysis, we quantified some details in the interviews while coding, that resulted in identifying six relevant variables for a case-oriented comparison (as shown in Table I). We recorded the direct, quantifiable measures, where possible, for the identified variables during the in-depth content analysis. For instance, the hypothetical duration of the crisis as anticipated by the SME (HDC), as well as the anticipated financial survival (FS) amid the pandemic, are the directly found measures that are quantified in years. Similarly, the amount and variety of digitalization projects (ADil and VDil), defined by the total number of projects were also mentioned by the interview partners as digitalization initiatives taken up by the company during the pandemic.

More subtle notions were also found during the analysis which were quantified using the calibration technique of the case-oriented qualitative comparative analysis (QCA) (Ragin, 1989), which uses the calibration of categorical answers into quantifiable measurements by assigning the values to the categories. For

example, in Table I, the investments made during the pandemic for digitalization (IiC) has been quantified via calibration. More specifically, we looked at the type of investments and assigned them values using the calibration scale, i.e., no investments are '0', minor investments equal '0.3', complete projects are represented by a score of '0.7', and a total renewal of a business would be classified as a '1'. A similar calibration scale was used to describe the reaction of the pandemic (RC) on the work practices before the pandemic. Ranging between no to severe reactions, '0' shows no change in practices, and '1' would describe drastic reactions like full closure of a business. In between the reaction scale, '0.3' describes minor reactions like implementing the disinfection and physical distance like strategies on-site, while '0.7' would be a substantial reaction with (partial) change of practices like allowing employees to work remotely in the home office, less hours or alternate days of work.

Table I. Dimensions of case-oriented comparative analysis

<b>Variable</b>	<b>Description</b>	<b>Measurement</b>
<b>HDC</b>	Hypothetical Duration of Crisis	In years (0.25 = quarter a year, 0.5 = half a year, 0.75 = three quarters of a year and so on)
<b>FS</b>	Financial Survival	In years (0.25 = quarter a year, 0.5 = half a year, 0.75 = three quarters of a year and so on)
<b>RC</b>	Reaction to Corona	Intensity of reaction to crisis as change in work practices (0=No Reaction, 0.3= Minor Reaction, 0.7= Substantial Reaction, 1=Drastic Reactions)
<b>IiC</b>	Investments during Crisis	Investments in new projects (0=No Investments, 0.3=Minor Investments, 0.7=Project-specific Investments, 1=Complete Business Renewal)
<b>ADiI</b>	Amount of Digitalization projects in Crisis	Number of projects via the adoption of digital technologies (indications of rushed digitalization)
<b>VDiI</b>	Variety of Digitalization projects in Crisis	Number of different projects; adoption of various digital technologies for interconnection between faculties of business (aligned with technology groups mentioned in Table 1, Section 3.1)

These dimensions were applied throughout the interviews to build a basis for case-oriented analysis. The individual case-oriented results (meta-analysis), along with interview metadata, are shown in Table II. Additionally, we have calculated the respective means and standard errors for each dimension across all the cases to show an accumulative trend as per these dimensions from thirty SME representatives. The aim of the comparative and content analysis is not to generalize the phenomenon of technology adoption for SMEs, but to perform an intersubjective evaluation of the expected technology adoption and impacts amid and after the pandemic in these SME cases.

## Trends in Comparative Analysis

The overall trend in the comparative analysis suggests that the interviewed SMEs, on average, started at least one new project associated with technology adoption for digital interconnection during the crisis within their specific fields of operation. It points out the reactive nature of SMEs as organizations (Blatz et al., 2018; Burnard et al., 2018), because the adoption of technologies was influenced by the need to mitigate crisis. This contrasts with the resilience focused organizations which are proactive ensuring the right skills and resources are in place to deal with the unforeseen situations.

Table II. Quantified Results of Interviews and Interview Metadata

Metadata of the interview partners and SMEs				Case-oriented quantified dimensions					
Firm	Case (Business Sector)	Total Employees	Interview partner	HDC	FS	RC	IiC	ADiI	VDiI
F1	Fitness-Health	1-10	CEO	0.25	1	0.3	0	2	1
F2	Training	10-20	CEO	1	>3	0.3	0	2	1
F3	Construction	1-10	CEO	2	0.5	0.7	0.3	0	0
F4	Hunting-Leisure	1-10	CEO	1.25	2	0	0.3	0	0
F5	Consultancy	1-10	CEO	1	1	0.7	0.7	3	3
F6	Print-Stationery	1-10	CEO	1	>3	0.7	0.7	2	2
F7	Retail	10-20	Manager	0.5	0.5	0.3	0.7	0	0
F8	Consultancy	10-20	CEO	2	1	0.3	0	1	1
F9	Retail	10-20	CEO	0.75	>3	0.7	0.7	3	2
F10	Planning	20-30	CEO	1.25	>3	0.3	0	2	2
F11	Photo-Media	1-10	CEO	1	0.25	0.5	0	1	1
F12	Wine	10-20	CEO	2.25	>3	0.3	0	0	0
F13	Chemical	80-90	CEO	1	0.25	0.7	0.7	0	0
F14	Prof. Services	40-50	CEO	0.5	0	0.7	1	1	1
F15	Hotel	1-10	Manager	0.5	0.5	0.7	0.7	1	1
F16	Advertisement	1-10	CEO	1	>3	0.3	0.7	3	2
F17	Food-Beverages	20-30	CEO	1	0.5	0	0	3	3
F18	Wholesale	30-40	CEO	1	0.25	0.7	0	1	1
F19	Textile	30-40	Manager	1	0	0.7	0	3	3
F20	Mechanical	1-10	CEO	1	0.25	0.3	0	0	0
F21	Prof. Services	10-20	Manager	0	>3	0.3	0.7	1	1
F22	Sanitation	1-10	Manager	2	>3	0.7	0.7	0	0
F23	Planning	1-10	CEO	2	>3	0	0	0	0
F24	Fitness-Health	1-10	Employee	0.25	>3	0.7	0.3	2	2
F25	Restaurant	1-10	CEO	2	1	0.3	0	1	1
F26	Painting-Decor	10-20	Employee	0	>3	0.3	0.7	0	0
F27	Food-Beverages	90-100	CEO	3	0.25	0.3	0.3	0	0
F28	Construction	1-10	CEO	0	2	0	0	0	0
F29	Restaurant	140-150	CEO	2	3	0.7	0.7	1	1
F30	IT	210-220	Manager	2	1	0.7	0.3	1	1
<b>Mean</b>				1.15	1.61	0.44	0.34	1.13	1
<b>Standard Error</b>				0.14	0.22	0.05	0.06	0.20	0.18

However, some of the interviewed SMEs did not consider adopting new technologies during the pandemic due to the type of business sector and nature of



business operations like companies from construction, hunting and planning etc. Some companies, however, used the crisis more intensively than others. Five companies started at least three technology adoption projects also with a variety of digital technologies from the earlier identified groups of digital technologies. It is also worth mentioning that a direct relation between the amount or variety of digitalization projects and the potential resilience of an SME cannot be found directly within our sample. To find this relation with resilience, we used the calibrated variables like the investments during the crisis in digitalization projects (IiC), and the reaction to the crisis (RC).

The comparative analysis using calibrated measures revealed that the businesses that report an expected long financial survival even with a crisis (like sanitation, planning, construction companies) are not always keen to invest in new digitalization projects considering no substantial impact of crisis or even an increase in business due to crisis. However, this also cannot be taken as a generalization because there were also companies like print, retail and planning which started digitalization projects amid the pandemic and reacted to crisis with substantial measure viewing the crisis as an opportunity to digitalize work processes. Even the companies belonging to the same business sector reacted differently to the crisis and towards technology adoption like retail and planning companies show inconsistent patterns which also demonstrates that generalization is not possible to actualize the behavior of companies within one business sector.

On the other hand, the pandemic affects some businesses sectors more as compared to others, which is revealed by low levels of financial survival period and reacting substantially to crisis by changing work practices to stay afloat. Interestingly, these companies also show multiple new digitalization projects during the crisis and in the near future, which is their anticipated measure to increase resilience against crisis through rushed technology adoption. This is not the case for all the businesses as can be seen from the comparison by investment during crisis, reaction to crisis and digitalization projects.

The comparison identifies organizations with not drastic reaction to crisis but still investing in digitalization which means that these companies have means to survive and are operational amid the pandemic but view it as a chance to adopt technology (like food-beverages and advertisement). However, there are also companies which expect a prolonged crisis and must react substantially or drastically to the crisis by changing work practices to alternate days of work or less hours need to adopt technologies as a mean to survival (for example print, wholesale and restaurant). It can be explained by the industrial sector in which an SME is operational and the type of business model they employ for business organizations. Companies that are typically more traditional and work in manufacturing or services requiring hands-on personal involvement seem to invest less into digitalization. This would hold true for sectors like construction, offline trading, supermarkets, and chemical suppliers. On the other hand, sectors like

media, online trading, health, training, or consultancy seem to be, on the one hand, rushed into digitalization and, on the other hand, use the pandemic as an opportunity to enhance the potential applications of digitalization within their respective fields of activity.

It seems obvious that the business sector has an influence, but it is one of the factors, among others like size, environmental changes, peer pressure, consumer demands, and above all, the need to have a continuous business. This also signifies the notion of organizational resilience that affirms the behavior of an organization to mitigate the change in order to reach stability after turbulence (Burnard & Bhamra, 2011). The adoption of digital technologies in some sectors, more than others, finds the demand for digital technologies of interconnection as a resilience-boosting measure to mitigate turbulence caused by the pandemic. We do think, nevertheless, that the decision when to and how to adopt digital technologies is not driven just by disruptions or crises. Strategies, personal decisions, innovation, use dependencies, and underlying premises, among others, also act as contributing factors for technology adoption (Aidah et al., 2017; Hoffmann et al., 2019). The results presented in terms of the differences from a case-oriented comparative analysis of the interviewed SMEs will be further elaborated with the content analysis to understand the importance and variability of reasons for technology adoption for digital interconnection in SMEs as a measure to boast resilience and agility.

## Content Analysis Findings

### Implications of the Pandemic for Technology Adoption

The content analysis reveals, with the start of the pandemic in March/April 2020, followed by restrictions for on-site work, which quickly snowballed into lockdown, resulting into different reaction from the companies from full scale business closure for some days to remote work or alternate working days, restricting only the selected employees at workplaces. This was followed by implications like supply-chain disruptions, declining customer base, problems with order completion, decreased production, and services due to ‘physical distance’ restrictions etc. The uncertainty interrelated with the rapidly changing situation caused multiple updates from the business organizations to employees, customers, and other stakeholders. This triggered a severe lag in communication, and the spread of false information was inevitable. As mentioned by an interview partner:

Shortly after this crisis broke out, an employee wrote to us and offered that she would waive her salary, if we were not doing well. And that's when we noticed that there was a lag in communication. So, we immediately reacted that we were fine. We can pay the salaries. You don't have to worry about that (F21, Prof. Services).

The analysis also revealed that the business organizations that were already using digital technologies at the start of the pandemic had a competitive advantage

and went into a smoother transition during the various stages of lockdown and restrictions. These companies showed resilience and agility to the rapidly deteriorating business scenarios during the pandemic. Technologies which were already a part of organizational infrastructure became prominent during the crisis and allowed these businesses to remain operational. These organizations felt less need to resort to new technologies, as shared by an interview partner:

We have no new digitalization projects planned, especially because of Corona. We are currently represented on social media and also have a WhatsApp business profile. We already have a few projects going on, before Covid, such as developing an app for smartphones and more. We don't feel the need to rush into new technologies because we are working as normal (F27, Food-Beverages).

Likewise, another participant mentioned that they are adopting digital technologies not to keep their business alive but to increase the efficiency of their business operations during the pandemic. This identifies a managed approach to technology adoption, where the agenda behind technology adoption is not to meet the essential business operations but to improve the performance of the business. They also said that:

There are for sure additional topics we work on now for our efficiency. Our web-shop is to be named here. Additionally, we should mention the direct connection to our marketplaces that we are building through digital means (F9, Retail).

It also reflects the type of business model a business organization follows to operationalize its business. A business model with flexibility, agility and proactiveness is more resilient and this agility comes with an already existing technological infrastructure which is proactive to changes in the business environment (Burnard et al., 2018). An interviewee explained that their existing technologies make them flexible during the pandemic and they can make their business more proactive by adding more straightforward measures. They further elaborated that:

Our strategy does not require any additional measures. We don't want to extend our advertising efforts to get sustain our business during pandemic, but we want to make the homepage more SEO capable. We also have a second homepage in mind with a different domain and staff is working on that right now. (F2, Training).

Some companies went a step further in technology usage and did use innovation with their adopted technologies to turn the crisis into an opportunity. This kind of use innovation triggering from a breakdown is synchronous with the concept of use innovation in the CSCW literature on infrastructures (Ludwig, Pipek, et al., 2018; Pipek & Wulf, 2009). As an interviewee explained that in addition to continuing everyday work in digital form, they have taken up the opportunity to reach out to their customers and reassure them of their services and that they will be taken care off even during the crisis. They added that:

We have intensified and improved a new form of communication with our existing customers as well as addressing potential new customers and we have ramped up the pace. That we push ourselves using our customer base and history with them and say 'Hello, we're still in contact

with you! We are not cutting work hours. We can perform at full capacity', and we try to communicate that to our customers. (F14, Prof. Services).

Our findings also highlight that business organizations used the pandemic crisis to experiment and learn about different digital technologies which can aid them during emergent situations. The learning through coping part of resilience (Burnard & Bhamra, 2011; Egner et al., 2015a), was also found in the analysis, and this learning has led to technology adoption in some SMEs. This further emphasize the need for a processual mechanism for technology adoption for resilience, where digital technology adoption improves resilience by building adaptive capacity and presenting multiple coping strategies against crises. Reciprocally, the acquired resilience resulting in technology adoption by experience and learning gained by coping after and during crisis mitigation while using technology. As expressed by an interview partner:

The working landscape is changing, and we have certainly learned a lot here in this Corona period. We have learned how to work in a home office and still keep in touch with our colleagues. We have learned how to make decisions in video conferences, and these will certainly be topics that will continue beyond Corona [...] we have used these to work further, um, in particular in E-commerce and other technologies [...] we also used the time to deal with topics that have been pushed back again and again in the past [...] taking the next steps and are certainly much further ahead with these topics after Corona than before Corona (F7, Retail).

#### The phenomenon of rushed technology adoption

Unlike some businesses where technology usage led to increased resilience and potential for improvement, the pandemic crisis had other consequences for some of the interviewed firms. Some companies were rushed to adopt and use digital technologies to virtualize the business operations in a non-processual manner, specifically, for inter- and intra-digital interconnection of an organization i.e. collaboration, communication and external digital interconnection with customers. As explained by an interviewee,

Then, of course, a faster transfer of information was needed. Despite everything, we have now set up a WhatsApp group with all employees, in which it is also, yes, as far as it is possible for someone, obligatory to be inside [...] However, given these unique circumstances, it is far simpler to tell everything to everyone (F19, Textile).

Organizations that were rushed to use digital technologies, pertaining to restrictions at large, also expressed concerns like lack of knowledge and lack of experience with technologies, which made it not an easy transition for them considering the type of industrial sector and the business model of those organizations. A small business executive expressed this dilemma that he lacks the knowledge and know-how of these technologies (F1). He further explained that they know the need to adopt several technologies for interconnection because it is a matter of survival for them now in times of crisis. Still, their lack of experience and knowledge about digital technologies and their usage will affect their business, making it not a decision of choice but something they must do. The analysis also

revealed that the lack of knowledge and experience is directly proportional with the skills of employees to use the adopted technologies. An interviewee from a different company reciprocated this notion and further added to this insight as:

I try to convince my employees to get involved in the new projects. That's essential but the problem is that most of them are not very familiar with digitalization and new technologies (F2, Training).

As, using technology in day-to-day business operations requires learning to use the technology and developing a skillset for the technology (Kinnula et al., 2018; Piccolo & Pereira, 2019), that cannot be generated overnight in employees, even if the organization wants the employed personnel to learn and adopt digital technologies. Due to changing operational dynamics in SMEs with the forced and rushed adoption of digital technologies, the demand for potential employees with technology-related skills increased. A medium-sized hiring agency expressed these concerns related to the change in the expectations of SMEs for new employees:

For us it will certainly also be a challenge to conduct the discussion with medium-sized companies about what the position profiles will look like in the future and also the framework conditions for them [...] companies that were extremely conservative in the past and are now more or less forced to open-up to topics such as home office with flexible working hours, shift models also in the commercial area and administrative structures [...] of course, the collaboration changes: Which tools does someone has to master, which communication technologies, where or how competent does someone has to be with different technologies? (F8, Consultancy).

The results emphasize on the processual mechanism for technology adoption with a mechanism to iteratively increasing the technology-related skillset within an organization by giving learning opportunities and experience with technologies required by the business. This long term and processual mechanism correlate with the notion of infrastructure in the CSCW literature which illustrates the longevity in reach and scope required for the establishment of practices and technologies, embedded and emerging from the existing conventions of practice to be learned as a part of membership to the process (Karasti et al., 2010; Karasti & Blomberg, 2018; Star & Ruhleder, 1994). Infrastructuring efforts are required within SMEs, as it was found in the analysis that this processual construction of technology infrastructure is means to achieve resilience, as we can interpret from the insights shared by an interviewee:

So, the online store was now the first thing that we just created so. That's of course the easiest thing for the customers to do, just click on it and get delivered [...] we want to be more active on social media, to remain in contact with the customers and of course also not to fall into oblivion [...] Then we offer so-called video consulting. So, that you call us via WhatsApp and then video call, and that you then make a personal shopping with your favorite shopping consultant quasi via videotelephony [...] It is a long process, and we have a long way to go (F19, Textile).

This processual adoption of digital technologies as perceived by business organizations is not just logical but also strongly resonates with the concept of resilience: Organizational resilience is an acquired characteristic that is developed

through a long-term process by initiating coping strategies, building adaptive capacity, and coping with an actual crisis and – in the long run – by evaluating past experiences of coping as part of a learning process (Burnard et al., 2018; Egner et al., 2015b). Also, as expressed by an interviewee:

About digitalization, as we honestly said earlier, we took the first steps, but only what you had to do [...] And now we've really made great strides again in the area of digitalization [...] So, we now use the time to experiment and then draw upon our learnings, what worked? What didn't work? What can we use for our future? (F13, Chemical)

The content analysis of the interview dataset, showed patterns of technology adoption which are dissimilar to the trends from the pre-pandemic expectations, specific for the interviewed SMEs. Our findings suggest that the interviewed SMEs strived for internal digital interconnectivity and work articulation at the start of the pandemic, because the pandemic crisis was an unforeseen and unexpected situation for these organizations. The efforts for crisis mitigation through rushed digitalization were undertaken by some of the analyzed organizations because of the lack of technologies in-use, uncertainty and evolving scenarios arising since the start of the pandemic and related restrictions. Organizations searched for ways to continue collaborative work and task coordination and build cooperation between distinct units of a business organization through digital means.

As the pandemic crisis prolonged and the customer base started to decline, the necessity arose for digital means to reach the customers directly. The companies with established digital means to reach the customers had a competitive advantage as they could still sell their products and services. Some of the companies did not have means to digitalize their market spaces. These companies specifically went into rushed digitalization by setting up profiles in available digital marketplaces or started using the technologies for external interconnection with customers. However, the expected increase in the usage of advanced technologies for information processing was not found in the analysis of the interviewed SMEs. This can be interpreted as the SMEs were striving to stay afloat by adopting the required technologies for internal and external interconnection, the advanced technologies were not adopted. This can also point to one of the limitations of our study, as the interviewed set consist of only thirty SMEs from a rural industrial region in Germany and not from all business sectors.

## Discussion

The pandemic crisis disrupted the ways of working and collaborating, affirming that there are hidden, unforeseen, and emergent factors with the potential to alter the usage and adoption of work practices and technologies. The learning opportunity for CSCW research post pandemic times, with the context of SMEs, broadens the horizon of action research by breeding novel focuses for emergent scenarios like organizational resilience that have the tendency to alter work

practices and the technologies for supporting cooperative work. Organizational resilience is a concept heavily researched in management and business studies that talks about building adaptability and agility in an organization against changes and disruptions (Burnard et al., 2018; Burnard & Bhamra, 2011; Lee et al., 2013). This requires the appropriation of work practices, tailoring the adoption and usage of digital technologies and fixing the technological infrastructure in modular increments (Pipek & Wulf, 2009; Syed et al., 2021).

Different crises have unique impacts on business activities in SMEs, and our research highlights that the adoption of digital technologies for interconnection before a crisis, through a processual mechanism, is a crucial factor for crisis preparedness and organizational resilience (Pipek et al., 2014; Syed et al., 2021). In our research, we explored the state of technology adoption in SMEs for impacts to implications. First, there are the SMEs in the interviewed set that adopted technologies for digital interconnection and demonstrated agility in dealing with crises and enhanced organizational resilience through a smooth transition of work practices during the pandemic. These organizations showed a faster reaction to the crisis, and they expect to recover from the impacts of the crisis in a shorter duration of time. These organizations viewed the pandemic crisis as an opportunity to appropriate work practices through technology-induced use innovations and invested in further technology adoption post pandemic.

Second, there are the SMEs in the interviewed set that did not digitalize interconnection between business faculties before the pandemic crisis. With the advent of the pandemic, the organizational infrastructures and process scrambled without or with the breakdown of the technological infrastructure binding the organization. These organizations rushed into technology adoption for interconnection and had to make hefty investments in digital technologies (Faraj et al., 2021). These businesses demonstrated less expected financial survival and expectations to stay in crisis for a longer period. The results also pointed out the disparity in the perceived usefulness of digital technologies indicates the incoherence in the technology-related skillset of an organization, before the pandemic crisis for adopting the much-needed technological interventions. However, the rushed digitalization phenomenon established new requirements for employees and organizations demanding rapid skill development to understand, plan and use digital technologies for interconnection and cooperative work. It also increased the demand for personnel with the required skillset for the usage of adopted technologies.

The disparity between SMEs' and the rushed technology adoption due to the pandemic also identified the lack of processual technology adoption in SMEs. We identify this as a need for infrastructuring for resilience through processual technology adoption by recursively increasing the usage of technologies for interconnection and the technology-related skillset in an organization. This evolutionary process aims at embedded resilience in an organization to adapt and

continue in the changing environment and resonates with the infrastructure and infrastructuring discourses in CSCW and related fields (Karasti et al., 2010; Karasti & Blomberg, 2018; Ludwig, Pipek, et al., 2018; Syed et al., 2021). This widens the research lens on technology adoption and resilience with prospects to study infrastructuring ethnographically in SMEs. The long-term processual nature of technology adoption and the relationality of ontological dimensions required for organizational resilience, when considered under the lens of infrastructure and infrastructuring, present interesting arenas for further research in CSCW.

## Limitations and Conclusion

In addition, our study comes with limitations that also suggest opportunities for future research. First, the interview studies used in this research are done in the context of German SMEs, which may also differ from the SMEs in other parts of the world. Second, our study draws from the theory of organizational resilience (Burnard & Bhamra, 2011; Pries-heje & Baskerville, 2021) and technology adoption is considered as means to enhance resilience (Liu et al., 2008; Mark & Semaan, 2008; Semaan et al., 2016), but there can be other factors that contribute to organizational resilience in SMEs. The findings of the qualitative study are rigorous to the extent that the results are validated using in-depth content and comparative analysis but understanding the technology adoption under the lens of infrastructuring requires a longitudinal ethnography over extended time, which is also an agenda of our further research. The Covid-19 pandemic generated burgeoning complications for SMEs which tried to mitigate the effects of the pandemic by introducing technologies for digital interconnection and cooperative work. However, this rushed digitalization constricted the organizations further due to the inadequacy of the skillset and resources to support this change. The content analysis and the comparative analysis with QCA's calibration on the qualitative dataset unveiled the state of technology adoption and use in SMEs in-and-post pandemic. The analyses identified two types of business organizations, i.e., ones that were resilient through advancements in technology adoption and the ones that had to do rushed technology adoption for survival. The analyses further revealed that technology adoption depends on the acquired skillset of an organization and the processual evolution of technology used to achieve organizational resilience. We found that SMEs have an ad-hoc approach to technology adoption and lag in building organization resilience by adopting digital technologies for interconnection.



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