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Research article

Organizational resilience and digital resources: Evidence from responding to exogenous shock by going virtual

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ABSTRACT

Recent events have renewed attention to how organizations rely on digital resources in response to exogenous shock. Though the literature on organizational resilience indicates that this is best understood as a process through which organizational actors respond to a specific shock, most IS research attends to resilience as an outcome. Against that backdrop, we present a case study of how a university shifted to virtual teaching in response to a government-imposed lockdown during the COVID-19 pandemic. Adopting a digital resourcing perspective allowed us to reveal the organizational resilience process and the way digital resources shaped it. We found that the resilience process unfolded in stages as educators, assisted by students, managers, and IT personnel pivoted, adapted, and normalized into teaching virtually. Across these stages, digital resources took on specific roles as the resilience process progressed from the organization's pre-shock accumulation of digital resources into its continued digitalization efforts. Based on these findings, we contribute to existing literature by advancing and empirically substantiating a process view of the role of digital resources in organizational resilience.

1. Introduction

Recent events of major exogenous shock have reinvigorated Information Systems (IS) literature on resilience (Boh, Constantinides, Padmanabhan, & Viswanathan, 2023; Liu, Xu, Jin, & Deng, 2023; Park, Son, & Angst, 2023; Rai, 2020; Tremblay, Kohli, & Rivero, 2023). Since exogenous shocks are existential threats that pose continuous and long-term risks to different entities, they have widespread implications for IS research and practice. Exogenous shock can disrupt normal IS functioning by causing damage to digital infrastructure, data centers, and other critical systems, but they also represent opportunities for innovation by leveraging digital technologies to transform current operations. The global COVID-19 pandemic disrupted many aspects of daily life and led to national lockdowns, social distancing, and virtual work arrangements, and scholars have demonstrated how organizations, including higher-education institutions, were able to continue

functioning by leveraging digital technologies at the same time as creating opportunities for innovation (Barnes, 2020; Bhagat & Kim, 2020; Carroll & Conboy, 2020; Carugati et al., 2020; Chatterjee et al., 2021; Pandey & Pal, 2020; Ratten, 2022).

To help understand such responses to exogenous shock, a rich body of literature has evolved under the conceptual umbrella of organizational resilience (Vogus & Sutcliffe, 2007; Williams et al., 2017) with roots in such varied disciplines as ecology (Holling, 1973), engineering (Hollnagel et al., 2006), economics (Gittell et al., 2006), and psychology (Masten & Obradović, 2006). However, although this literature indicates that resilience is best understood as a process in which organizational actors continuously learn from their responses and feed the insights they gain into modified and new responses (Williams et al., 2017), extant literature lacks empirical and theoretical insights into the role played by digital technologies in shaping organizational resilience over time (Müller et al., 2013). Hence, current IS research offers only

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what some have termed "a narrow and shallow understanding of resilience" (Heeks & Ospina, 2019, p. 73), attending disproportionately to outcomes rather than to how resilience comes about.

Given that researchers have long sought to understand how digital technologies contribute to turbulent environments (Butler & Gray, 2006; El Sawy, Malhotra, Park, & Pavlou, 2010; Salovaara, Lyytinen, & Penttinen, 2019; Sambamurthy, Bharadwaj, & Grover, 2003), there is ample opportunity to address this void based on the foundational insight that what matters is not technologies per se, but what people can do with them. Accordingly, we adopt a resourcing perspective (Deken et al., 2018; Feldman, 2004; Linnenluecke, 2017) and shift our attention to the broader notion of digital resources defined here as *digital technologies, their use, and the related experiences and skills that enable organizational action* (Melville et al., 2004; Sandberg et al., 2014; Vogus & Sutcliffe, 2007). This framing allows us to examine the organizational resilience process and the way digital resources shape it over time (Sandberg et al., 2014; Vogus & Sutcliffe, 2007). In addition, it allows us to consider not only digital technologies and their use, but also the related experiences and skills of organizational actors (Feldman, 2004; Melville et al., 2004). Hence, we ask the following research question: *How does organizational resilience unfold as actors leverage digital resources in response to an exogenous shock?* This calls for careful attention to the role played by digital resources, including the ways in which they are accessed, mobilized and activated to enact specific response strategies (Linnenluecke, 2017; Hillmann & Guenther, 2021).

To address the research question, we investigate how a Danish university shifted to virtual teaching following a government-imposed lockdown during the COVID-19 pandemic. We provide a detailed account of how educators, assisted by students, managers, and IT personnel, leveraged digital resources to pivot, adapt, and normalize into virtual teaching. In addition, we explain how digital resources took on different roles across these stages as the resilience process unfolded and propelled the organization forward from the pre-shock accumulation of digital resources to its continued digitalization efforts. Together, these insights allow us to advance and empirically substantiate a process view of the role of digital resources in organizational resilience, as a contribution to the literature.

2. Literature background

2.1. Organizational resilience

Derived from the Latin *resilire*, "resilience" means to bounce back or recover from a disturbance (Hollnagel et al., 2006). The concept originated in ecology research (Holling, 1973), where it referred to a system's ability to withstand and survive disturbances, but has since generated significant interest across scientific disciplines where it represents "a broad conceptual umbrella, covering many concepts related to positive patterns of adaptation in the context of adversity" (Masten & Obradović, 2006, p. 14). Its usefulness as a scholarly concept is debated (DesJardine et al., 2019) because resilience has been defined, operationalized and applied differently across multiple fields of study, including individuals, groups, and organizations. Still, there is general agreement that resilience is an important concept in understanding how organizations "respond to and recover from duress or disturbances with minimal effects on stability and functioning" (Williams et al., 2017, p. 740). In organization and management science, scholars have used the concept to define not only the organizational characteristics that maintain desirable functions and outcomes under challenging conditions (Linnenluecke, 2017) but also the dynamics that are involved in responding and adapting to unexpected events (Vogus & Sutcliffe, 2007).

These definitions reveal a tension between an outcome and a process view of organizational resilience. Resilience as an outcome means an organization is able to "rebound from unexpected, stressful, adverse situations and to pick up where it left off" (Lengnick-Hall et al., 2011, p.

244). This reflects an assumption about organizational function and performance as optimal equilibrium states (Holling, 1973), where resilience is the outcome of a "perfectly elastic mechanical system, where any energy that is absorbed can be emitted without any losses, returning the system to its previous stable state" (Limnios et al., 2014, p. 105). Some scholars consider resilience as "bouncing back" from disruptions (Holling, 1996; Holling & Gunderson, 2002), while others consider it as "bouncing forward" from adversity into a new, stronger, and more resourceful stable state (Carpenter et al., 2001; Folke et al., 2010).

A process view instead considers resilience as a dynamic interaction between an organization and its environment, which is inevitably shaped by the nature of the disturbance and the behavior of the actors involved (Nadasdy, 2007). This process unfolds through the actions organizational actors take when they respond to an exogenous shock and gain new insights that feed back into their ongoing organizing efforts (Williams et al., 2017). This reflects an assumption about organizations as constantly evolving, and stability as moments of only temporary stasis that can change suddenly and become something profoundly different from before (Pike et al., 2010). When faced with exogenous shocks, organizations hardly ever return to where they were (Davoudi, 2012), and scholars in this view therefore decouple resilience from outcomes of organizational stability or growth because they see it as "a part of organizational healing that occurs after a crisis" (Hillmann & Guenther, 2021, p. 31). There is broad indication in the literature that organizational resilience processes typically emphasize pre-adversity organizing, the immediate shock response, situation-specific adaptations, and future-oriented transformations, in a non-linear fashion (Lengnick-Hall et al., 2011). In this way, resilience is not a fixed or universal attribute, but rather a dynamic response process that unfolds over time, as organizational actors take action, reflect on unexpected events and incorporate feedback from their actions into ongoing resilience efforts (Williams et al., 2017).

A key point of contention between these two views is the "moment" where resilience can be observed (Williams et al., 2017). From an outcome point of view, building resilience is about the implementation of generic measures that are designed to absorb variations and maintain functions (Carpenter et al., 2001), but its outcome is observed as the moment where an organization returns to its equilibrium state *after* an exogenous shock (Holling, 1996; Holling & Gunderson, 2002). Meanwhile, ample evidence suggests that response strategies are more effective when they are tailored to a specific shock and consider how its characteristics (such as its nature, cause, and complexity) interact with the specific characteristics of the organization (such as its structure, culture, and resource endowments). For example, an organization with strong financial resources may be better able to weather an economic downturn than one with limited financial resources, while an organization with digital resources is better equipped for dealing with a communication and connectivity crisis than an organization without. Scholars taking the process view therefore question the claim that certain factors or conditions will lead to resilient (or non-resilient) outcomes because it fails to account for the dynamic nature of a response to exogenous shock (Linnenluecke, 2017). In lieu of trying to guarantee specific outcomes, they advocate more nuanced understandings that recognize the role of agency and context (Pike et al., 2010) and underscore that resilience is about the resources and flexibility to respond to a wide range of threats and disruptions (Hillmann & Guenther, 2021). In the process view, the moment of organizational resilience therefore extends *before* exogenous shock (Williams et al., 2017), where already accumulated resources may shape the actions that organizational actors can take to enact an effective response. This, in turn, calls for careful attention to the role of resources, including the ways in which they can be accessed, mobilized and activated to enact specific response strategies with onset of exogenous shock (Linnenluecke, 2017). However, the literature on organizational resilience gives no special credence to the role of digital resources, despite

acknowledging their importance in responding to exogenous shock.

2.2. Resilience and digital resources

While it is unsurprising that recent events of exogenous shock have spurred interest in resilience as a conceptual umbrella for transformation in the face of adversity, the IS literature attends mostly to resilience as outcome (Table 1). The prevailing rationale is that by studying how different entities use digital technologies to respond to shock, researchers and practitioners can identify factors and characteristics that impact resilience as well as best practices for building resilience capabilities, measure their effectiveness and suggest improvements (Heeks & Ospina, 2019). As such, the IS literature offers many insights into the different properties of resilient information systems in the context of intrusion prevention, communication networks and cyberinfrastructure (Erol et al., 2010; Omer et al., 2009; Smith et al., 2011; Zobel & Khansa, 2012) and the impact of technology on generic resilience indicators, for example in increasing reliability (Salovaara et al., 2019), strengthening collaboration (Floetgen et al., 2021), reducing flexibility (Ignatiadis & Nandhakumar, 2007; Riolli & Savicki, 2003) and curbing long-term sustainability (Márton, 2021).

Accordingly, the literature demonstrates that digital resources matter for resilience, but how it matters is an open question. While the outcome view prevails in the IS literature (Heeks & Ospina, 2019), we know from the literature on organizational resilience that this view cannot adequately account for the important role played by agency and context (Pike et al., 2010; Davoudi, 2012). Moreover, we know that effective response strategies are tailored to the interactions between the specific characteristics of a shock and the organization. Recent work has made important contributions in this regard by demonstrating that specific characteristics of digital technology interact with different stages in the resilience process, for example through redundancy and sensing (for absorbing the initial shock), accessibility and experimentation (for adapting to situation-specific challenges), and scalability and reconfigurability (for transforming operations accordingly) (Boh et al., 2023). These advances pave the way to the cross-fertilization of insights elucidating the roles played by digital resources within different stages in the resilience process. Hence, to provide a granular understanding of how digital resources matter for resilience, we must not only account for the characteristics of the shock, of the organization, and of the digital resources involved, but also for how these characteristics interact and contribute to response strategies over time.

Adopting a process view, the purpose of this paper is to investigate how resilience unfolds as organizational actors leverage digital resources to enact a specific response strategy during an exogenous shock. We know from previous IS process studies that the relationship between digital resources and resilience is complex and potentially fraught with tensions. Recent findings show that resilience evolves with long-term digitalization as "both the organizational challenge and its

Table 1
IS studies of resilience.

	Outcome view	Process view
Definition	Resilience is the property of an organization that continues with or returns to optimal functioning after adversity	Resilience is the process by which organizational actors leverage resources to adjust or maintain functioning in response to adversity
Related IS research	Erol et al. (2010);Floetgen et al. (2021);Ignatiadis & Nandhakumar (2007);Liu, Xu, Jin, & Deng, 2023;Omer et al. (2009);Park, Son, & Angst, 2023;Riolli & Savicki (2003); Smith et al. (2011);Tremblay, Kohli, & Rivero, 2023;Zobel & Khansa (2012)	Carugati et al. (2020);Cho et al. (2007);Fleron et al. (2021);Cui et al. (2021)

organizational and technological resolution" (Fleron et al., 2021, p. 2408), corroborating earlier insights that digital resources can simultaneously enhance and inhibit resilience outcomes. Moreover, fundamental tensions persist between short-term stability and long-term change (Cho et al., 2007; Heeks & Ospina, 2019), where the swift activation of digital resources can offer much-needed capabilities to cope with a shock in the short term (Carugati et al., 2020; Park, 2023), while unravelling the social fabric of the organization in the long term (Orlikowski & Scott, 2021; Tim, Cui, & Sheng, 2021). Hence, by attending to the actions through which organizational actors leverage digital resources in responding to a major exogenous shock, our aim is to advance knowledge on how digital resources shape organizational resilience as it evolves over time.

3. Research method

3.1. Study context

To address our research question, we draw on an in-depth case study (Yin, 2009) of how the Faculty of Social Sciences at Aalborg University responded when, on Wednesday, March 11, 2020, the Danish government announced that physical activity in non-critical public-sector organizations would be suspended to prevent the spread of COVID-19. The faculty's management decided to immediately shift all on-campus teaching to virtual delivery, with the result that educators had moved over to virtual formats a few days later (Haslam et al., 2021a). With this mandatory response, the faculty completed the spring semester with virtual teaching and avoided any major disruption of educational programs, in line with how "most higher education institutions shut down their campuses and transitioned to emergency remote teaching" (Park, Son, & Angst, 2023). Hence, we examine how the university recovered from the suspension of physical teaching by shifting to virtual teaching through a process that unfolded between mid-March 2020 and June 2020. Our study focused on the teaching practices applied by a group of educators assisted by students, managers, and IT workers as its unit of analysis. This research design was based on the insight that an organization can only be as resilient as its core groups of actors (Hillmann & Guenther, 2021).

3.2. Data collection

Following Yin (2009), our data collection involved multiple sources (Table 2). First, we conducted 60 semi-structured interviews (Kvale, 2008) with educators (assistant, associate and full professors), students, managers, and IT personnel. Our first round of interviews took place in the initial weeks of the COVID-19 lockdown of March–April 2020 (30 interviews), with follow-up interviews with the same participants at the end of the semester, in June–July (30 interviews). We carried out all interviews online (Iacono, Symonds, & Brown, 2016) in the Danish language, using Microsoft Teams or Skype for Business. They lasted one hour, on average. We adapted the interview guide to the four stakeholder groups, covering four broad questions to all groups about the shift to virtual teaching: 1) How was teaching delivered prior to the pandemic? 2) Which teaching activities were transformed for virtual delivery, and how? 3) How were the consequences, challenges, and benefits of the shift to virtual teaching experienced? 4) How was the transformation into virtual teaching supported by digital resources? All interviews were recorded and subsequently transcribed verbatim, and all presented quotes were translated from Danish to English. Appendix A provides an English-language version of the interview protocol.

Second, we included several document types. Because of the extreme situation, the faculty management emailed several announcements, procedure descriptions, and guidelines on virtual teaching to staff and students. We also had access to MS Teams forums where educators discussed virtual teaching. Among the additional data sources were a survey of educators (Appendix B) and a survey of students conducted at

Table 2
Data collection overview.

Theme	Method	Key sources	Count
How the management responded to the COVID-19 lockdown	Interviews	Dean Vice-dean Department heads [1,2] Deputy department heads [1,2]	2 2 4 4
How educators managed the shift to virtual teaching and what its benefits and disadvantages were	Interviews	Full professors [1, 2, 3] Associate professors [1, 2, 3, 4] Assistant professors [1, 2, 3]	6 8 6
How IT personnel supported the shift from physical to virtual teaching	Interviews	IT managers [1, 2, 3] Digitalization consultant [1]	6 2
How students experienced the shift from physical to virtual teaching	Interviews	Undergraduate students [1, 2, 3, 4, 5, 6] Graduate students [1, 2, 3, 4]	12 8
Information on the response to the COVID-19 lockdown	Documents	Email communication MS Teams discussion forums Digitalization strategies, PowerPoint presentations, and meeting minutes	122 emails 207 posts, 41 threads, 23 documents (423 pages)
Evaluation of the experiences with virtual teaching	Survey	Student questionnaire (May 2020) Educator questionnaire (June 2020)	632 respondents 115 respondents
Use of digital technology before and after lockdown	Descriptive statistics	Usage statistics for MS Teams and Zoom	

the faculty level (Appendix C), along with technology-usage statistics for before and during the lockdown, provided by the IT department.

3.3. Data analysis

We conducted our data analysis in three iterative steps, progressing from focusing on the analysis of the empirical data towards conceptualization (Walsham, 2006). First, we familiarized ourselves with the full dataset by reading the interview transcripts, studying documents, and analyzing survey results. As is common in qualitative process studies, we observed that numerous storylines coexisted in the empirical data. On the one hand, particularly from a managerial perspective, our readings revealed the case to be a success story of accelerated digital transformation of teaching despite the pre-shock resistance to virtual teaching. On the other hand, educators and students were affected by the trials and tribulations of coping with a rapid shift to virtual teaching amid unexpected circumstances. They expressed numerous concerns related to the quality of the teaching and struggled to overcome the limitations of the virtual environment. This led us to zoom in on how educators, assisted by students, managers, and IT personnel, transformed the teaching practices by leveraging digital resources in response to the lockdown.

Second, we relied on a digital resourcing perspective as a starting point and as our lens of analysis (Patton, 2002). Focused on the university's core teaching task, we identified specific instances of how actors "activated, combined, and recombined" digital resources (Vogus & Sutcliffe, 2007, p. 3418) and turned them into "resources-in-use" (Deken et al., 2018, p. 1923) to perform virtual teaching. In our coding process,

we strove to make sense of how educators leveraged various digital resources and to identify opportunities and challenges in their virtual teaching. As we coded the student, manager, and IT-staff interviews for the individuals' reflections on virtual teaching practices, we took notes to share our impressions and interpretations of the data, and we corroborated our interview-based findings with document reviews (Bowen, 2009). This coding provided two interrelated insights that became important for our conceptualization of digital resources in the organizational resilience process. First, we observed how educators, aided by the students, managers, and IT personnel, leveraged digital resources that had accumulated over time and thereby created a potential for a rapid shift to virtual teaching. Hence, in line with our process approach to resilience, we noticed how the past accumulation of digital resources was important for the organization's response to the pandemic, which, in turn, situated the shock response in the context of the organization's unfolding digitalization efforts. Second, we observed variations in how educators' engagement with digital resources to shift to virtual teaching evolved over time as the situation changed from being rather chaotic in the weeks after the shock to becoming more ordered towards the end of the spring semester.

Third, we used these insights in combination with temporal bracketing techniques (Langley, 1999) to identify a pre-shock stage and three recovery stages—pivoting, adapting, and normalizing—in the organizational resilience process. Based on our coding of the empirical material, we then identified evidence about each stage (Appendix E). This evidence gave insights into how, in each stage of the shift to virtual teaching, educators, aided by the students, managers, and IT personnel, leveraged digital resources, revealing the different roles that digital resources played in recovering from the exogenous shock. Overall, these three iterative analytical steps helped us cycle back and forth between empirical evidence and conceptualization to compose a coherent storyline (Golden-Biddle & Locke, 2006) that explains how university stakeholders responded to the government-imposed lockdown during the COVID-19 pandemic by shifting to virtual teaching.

4. Empirical analysis

The Danish government's announcement in March 2020 of a lockdown of all non-critical public-sector organizations to prevent the spread of the novel coronavirus immediately affected all operations of the social-science faculty at Aalborg University. One associate professor recalled: "It was a shock Wednesday evening when I came downstairs after putting the kids to bed and discovered that I was not going to work at the university the next day." The same evening, management decided that all teaching activities should shift to virtual delivery, to avoid disruption to teaching schedules and risks of delays in education programs. The managers informed students, educators, and other staff members that they had only one day, Thursday, March 12, to collect their belongings from university buildings and that all teaching would be delivered virtually from Friday, March 13, onward. This early decision to go virtual put digital resources at the front and center of the organizational resilience process. The dean explained: "Our teaching practices changed radically into virtual form between one day and the next." The following account details how digital resources accumulated at the university before the shock and the role digital resources played throughout the recovery stages of pivoting to virtual teaching, adapting virtual teaching, and normalizing virtual teaching.

4.1. Pre-shock accumulation of digital resources

Prior to the shock, the educators taught in an institutionalized, traditional way, predominantly engaging in conservative use of digital technologies during on-campus, in-class teaching with only sporadic attempts at virtual teaching. The dean explained that, irrespective of the increased management push for digitalization, attempts to introduce virtual teaching had "moved forward slowly," weighed down by intense

discussion and "resistance to change" among educators and students alike. However, digital resources that could be used for virtual teaching had gradually accumulated in the organization, alongside various degrees of using digital technology within and outside of teaching. While many of these resources were largely not recognized as valuable for virtual teaching by educators, managers, and students, they formed a basic infrastructure for organizational resilience whereby the university could, when required to do so, swiftly transform its work practices to a virtual format. Before the shock, various digital technologies were in use to support on-campus teaching: for activities related to study administration, education-connected communication, registration for exams, and more. Microsoft Outlook had also become the standard tool for email communications among educators and students, Skype for Business had been launched as the university's internal communication platform for both calls and instant messaging, and, most educators had for years used digital technologies "in all sorts of ways as part of research" (associate professor).

In their teaching, educators had widely adopted PowerPoint to structure lecture content, provide visual aids, and facilitate in-class discussion and assignments. As a full professor stated: "I always use PowerPoint to deliver my lectures and it is very integrated in my teaching practices." Similarly, access to library materials had been digitalized many years earlier, and course materials were widely available online as part of the university's digital infrastructure. These developments had culminated in the implementation, across the organization, of the learning-management system Moodle, which from 2010 onwards served as a common platform for coordinating courses, teaching materials, lecture information, assignments, and other elements between educators and students. Moodle afforded augmenting physical learning environments and moving them entirely online, but, before the shock, educators and students utilized only basic functions such as those for course lists, calendars, and file-sharing to supplement on-campus teaching activities.

Driven by various strategic initiatives for digitalization, the university had also invested in technologies such as Panopto, Mentimeter, Kahoot!, and Padlet that could directly support virtual teaching. To improve educators' skill set and provide an incentive for the uptake of those technologies, managers had integrated virtual teaching and digital didactics into the curriculum of mandatory pedagogical education for junior faculty members. While these digital resources were readily available, only few educators actively experimented with virtual teaching prior to the pandemic. Hence, although some aspects of blended learning were adopted, "not much happened with virtual teaching before the COVID-19 pandemic" (digitalization-consultant).

Notably, MS Teams—which became the most used virtual teaching platform at the faculty after the shock—was introduced at the university in 2017 as part of the MS Office 365 suite. An IT manager described it as having been "quietly introduced at the university, with only a few educators paying any attention." Before the lockdown, managers and educators did not see MS Teams as a teaching technology, but as a collaboration tool for project teams and as a campus-wide telephone system that could replace Skype for Business.

Hence, until the COVID-19 pandemic set in, digital resources had accumulated steadily over time. While no one before the pandemic had imagined that the university would shift fully to virtual teaching, many relevant digital resources were in place because of a long-term development toward a more digitalized university. Moreover, based on their own computers, coupled with good internet connections, the students had extensive experience of and advanced skills in using information technology for communication, computation, reporting, social media, information search, and more; thus, Aalborg University was woven into a strong infrastructure for virtual teaching by both the institution and by students. This accumulation of digital resources became important to understanding the university's recovery from the exogenous shock caused by the pandemic. A department manager told us: "It was not about purchasing new technology but about using the ones we already

had," and the vice-dean added: "If this had happened five or ten years ago, we would never have been able to pull it off. Now, however, we had a multitude of IT systems and digital technologies, which were immediately available to everyone."

4.2. Pivoting to virtual teaching

Pivoting characterized the initial post-shock response, in which educators swiftly shifted to virtual teaching. The suspension of physical teaching delivery was experienced as dramatic by educators as they pivoted to find ways to teach virtually under conditions of uncertainty. In the immediate aftermath of the shock, they did their best to deliver teaching with readily available technologies and largely by using further functionality of the technologies they were already using. A full professor explained: "Many of the digital technologies have been available for quite a while, but you only really notice them when you are forced to seek them out."

Educators were under immense pressure to rapidly reestablish their practices in a virtual space, with one assistant professor characterizing the accelerated uptake of digital technologies as following a spontaneous "trial-and-error approach." One associate professor started, for example, to use the voiceover function of PowerPoint as she faced pressure to convert a two-day lecture-based seminar to a purely virtual format within a few days. She chose to structure her lectures into asynchronous voiceover sequences with slides, because this technique was "the easiest and most accessible." Another associate professor noted: "Like many of my colleagues, I started using voiceover in PowerPoint. I always use PowerPoint in my teaching, but I had never used this feature before. I did not even know it existed." In this way, educators took advantage of their experiences with well-established teaching technology (e.g., PowerPoint) and exploited functions that they had not previously applied in teaching (e.g., slides with voiceover).

Such changes in teaching practices were supported by IT personnel and managers who shortly after the lockdown prepared guides and tutorials for virtual teaching. The digitalization consultant at the faculty stressed that she wanted to let educators and students know "that they were not alone, and we were doing everything we could to help them through this extreme situation." As a case in point, a deputy department head circulated on March 12, only one day after the government lockdown was instated, a list of options for virtual teaching by e-mail to all educators, about which he stated: "I advise against synchronous teaching unless you have experience with that type of technology. The IT department also advises against it.[1] If you do not want to use synchronous teaching, then there are good, simple asynchronous options with many benefits. I ask you to make your own decisions, depending on what will work for your teaching."

In describing the pivoting to virtual teaching, several educators referred to the experience as having "a steep learning curve" with surprises and setbacks. Preparing lectures involved devoting additional time to getting acquainted with new technology and to adjusting existing material on the subject and topic outlines for a virtual format. One assistant professor was initially keen on trying out Panopto to pre-record his lectures as videos, but experienced so many technical issues that he gave up and resorted to PowerPoint: "I ended up making a PowerPoint with voiceover, but then I had to divide it into four different chunks to make it work because otherwise the file was too big. Actually, it probably took at least a day just to redo the lecture that I had already prepared."

Moreover, experiences with otherwise well-known technologies such as PowerPoint in the physical space were not immediately reproducible in the virtual space. For instance, a full professor struggled to reestablish

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[1] The IT department advised against synchronous teaching at the start of the lockdown because it was unclear whether the existing technological bandwidth would suffice to support live-streaming for all lectures at the same time.

himself as a lecturer with a virtual lecture's pre-recorded form. Under normal circumstances, he used his 6′6″ physical stature and dry sense of humor to command the attention of his students. It turned out that this translated poorly to PowerPoint slides accompanied by an audio track. When recording his lectures at home, he therefore tried to emulate the lecture-hall experience, in hopes of projecting the same kind of energy: "I stood in the basement, in my children's playroom, which has plenty of space, and I mounted my screen on top of the dollhouse. I know that if I sit down, my voice drops, so I closed my eyes and imagined I was standing in front of the students." Where he normally would rely on "doing something awkward on purpose to break the ice" within the first 20 seconds from entering the room, he scrambled to find a good way to establish this practice with his invisible students. For a lecture on cultural history, he came up with an idea: he could use music matching the lecture topic as an icebreaker. Mimicking the style of a radio host, he began his lecture to the slowly fading tune of a tacky Danish pop song about summer and windy shores. He concluded, "When my students started playing that PowerPoint [presentation] they heard Birthe Kjær singing 'Summer and Sunshine,' I think I caught their attention." In this way, he combined different digital resources (PowerPoint, music) with humor to create interest in the subject matter and to compensate for the lack of physical presence.

Under normal circumstances, interacting with students in the classroom was highly valued as an integral part of the organization's brand as a Problem Based Learning (PBL) university (Haslam et. al., 2021b). But in the hectic days immediately after the lockdown announcement, most educators accepted, albeit with unease, that they had to be pragmatic with the didactics involved: "I felt a little apologetic about the pedagogical side of it, thinking, 'Now it's like this, it has to work, so I do the best I can'," said one assistant professor. Another associate professor noted: "We have been pushing the boundaries of what can be done at such short notice. It works for now, but it is challenging and certainly not the same as physical teaching." Although these educators were dissatisfied with the purely one-way communication offered by pre-recorded lectures, students seemed to accept the format in light of the unusual situation, with one remarking: "We are using a solution [voiceover in PowerPoint] that isn't perfect, and there are probably better solutions out there. However, given the circumstances, what we are doing is fine right now."

Accordingly, events immediately after the shock triggered an unexpected pivot to virtual teaching as the physical teaching practices were disrupted by the lockdown. During this fast-paced and hectic change, educators leveraged the digital resources available—asynchronous solutions such as PowerPoint with voiceover in particular—to facilitate the shift to virtual teaching. As an expression of organizational resilience, a department head described this process as one that "happened more painlessly than expected," with very few teaching activities getting cancelled or postponed as educators handled the new situation via whatever digital resources were required to "get the teaching done."

4.3. Adapting virtual teaching

The rapid shift to virtual teaching was followed by a less hectic stage, described by the dean as follows: "After about 3–4 weeks, we entered a new stage, when it became more operational even though this was still an extraordinary situation." That stage in the organizational resilience process was marked by deliberate efforts by the educators to adapt their virtual teaching to make the practices, which they had had to put together very quickly in the pivoting stage, more acceptable. In contrast to the previous stage, most educators chose not to continue to teach solely through pre-recorded lectures, but rather explored how to improve the quality of their teaching under the new circumstances.

The initial relief and surprise that a shift to virtual teaching had been possible did not eclipse the most urgent concern among educators: that the asynchronous activities provided merely one-way communication. This worry motivated many educators to invest more efforts into using

synchronous solutions based on technologies such as MS Teams, Zoom, Kahoot!, and Padlet to improve the interaction and dialogue with and between students. A few educators had experimented with synchronous live-streamed teaching from the very beginning of the lockdown, but it gained widespread uptake at this stage. To facilitate this adaptation in virtual teaching practices from asynchronous to synchronous formats, the faculty started offering courses on digital resource available for virtual teaching via MS Teams. Although MS Teams "before the lockdown never really was considered a teaching tool" (IT manager), it became the most used platform to stream lectures at the faculty (Appendix B). Use of MS Teams skyrocketed from a pre-lockdown level of 3600 users at the university (in February 2020) to 17,000 users by May 2020 (Appendix D). Its adoption increased rapidly, thanks in part to the university already having MS Teams as part of the MS Office 365 suite and therefore being able to scale and diffuse it quickly.

A key challenge for educators was to leverage digital resources to closely mimic their pre-shock experiences with on-campus teaching. By using MS Teams, and later Zoom,[2] to stream lectures, educators attempted to replicate the physical classroom's opportunities for dynamic interaction with students—such as clicking through slides and taking ad hoc questions from them. Thus, how interaction usually played out in the physical classroom took center stage in how virtual lectures should best be conducted. However, as an associate professor reflected, much was contingent on the students turning on their camera: "I always have video on. And I think several of the students in the beginning did too, but then it quietly tapered off. I don't know if it's because people haven't gotten out of bed, but I very easily lose sense of who is really paying attention and who is not." In some situations, educators decided to abandon certain teaching methods in response to the perceived limitations with the virtual format. For example, in the social-work education program, educators usually relied on roleplay as part of their teaching practices to train budding social workers in how to facilitate communication on sensitive social issues. One educator stated that she decided to suspend roleplaying entirely because she had no idea of how to establish a safe environment that could support the intimacy of the learning experience in a virtual setting. In situations such as this one, the shift to virtual teaching continued to cause problems and frustrate educators.

At this stage of the organizational resilience process, setbacks also led to continued adaptation of virtual teaching practices. This was particularly true for educators who began leveraging digital resources to combine asynchronous and synchronous activities. For example, instead of using MS Teams to transmit a full lecture in real time, some educators hosted shorter, joint discussion sessions as follow-up to pre-recorded lectures. In these, students could ask for clarification or engage in dialogue with the educator and other students. One assistant professor explained: "I made small videos in Panopto based on my usual lecture and put them on Moodle so the students could find them there. A few days later, I had a live session in Teams where I asked whether anything was unclear and whether they needed help getting started on the assignment. There wasn't really anyone who responded. So, I closed the live session after ten minutes and wrote to the students, 'Fine, work on the assignment and write questions in the MS Teams channel.' After a week, I recorded a new Panopto video where I answered these questions."

At first, this educator had intended to use Panopto, Moodle, and MS Teams to synthesize shorter pre-recorded videos with an assignment and a comprehensive discussion session. Yet, when confronted with students who engaged only minimally or not at all during the sessions, he was compelled to amend his approach to instead encourage students to pose

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[2] The university also decided to purchase an institutional license for Zoom, though one was not available until late April. Although Zoom was not the faculty's preferred platform (Appendix B), it still reached 3000 users by the end of the semester (in June 2020).

queries in the MS Teams channel, as questions occurred to them only during their engagement with the course material and working on the assignment. With his follow-up video recorded via Panopto, he then addressed these questions and distributed the video over Moodle. Although the lack of student participation was initially an issue in leveraging digital resources for organizational resilience, it led to the formation of a new virtual lecture format, enabled by a patchwork of digital resources.

These efforts were facilitated by knowledge-sharing, which had become more widespread and formalized at this stage. While the faculty offered courses in the use of MS Teams (and later Zoom) from April onward, knowing which digital resources were suitable for virtual teaching relied mostly on educators seeking out and sharing experiences. Faculty leaders used MS Teams to create numerous Q&A forums, where educators shared insights pertaining to how to undertake specific teaching activities in the virtual space. On April 27th, an associate professor received 23 responses within 88 minutes to the following questions: "Anyone with experience organizing exercises for students online? Most advice and links seem to be about lectures, which is fine, but what about exercises?" Hence, underscoring the importance of experiences and skills in digital resources, getting to know how colleagues approached virtual teaching was critical for educators as they strived to improve the delivery of their teaching in virtual formats.

Thus, in the second stage of the organizational resilience process, educators adapted virtual teaching practices by experimenting with live-streaming lectures, and combining asynchronous and synchronous teaching to support dialogue and interaction with students, which they previously had experienced as problematic. Educators used a wide range of technologies to integrate asynchronous and synchronous activities, and strived to improve virtual teaching through an emerging patchwork of digital resources.

4.4. Normalizing virtual teaching

As the semester neared its end, virtual teaching became normalized as teaching practice at the faculty. Educators had leveraged digital resources to first pivot to and then gradually adapt to virtual teaching to recover from the exogenous shock and "virtual teaching had now become the new normal," as one associate professor expressed it.

A professor further explained that there was "such a steep learning curve in the beginning—a lot of energy, enthusiasm, and interest was mobilized to try something quite different—and then a kind of routine set in." Even though the result was by no means equivalent to the institutionalized on-campus, in-class teaching prior to the shock, educators' practices eventually fell into two distinct patterns: live-streamed lectures of shorter-than-normal duration and pre-recorded videos supplemented by written assignments or online discussion-seminar sessions. While there were variations in the duration of live streams and pre-recorded videos, and while written assignments were mandatory in some cases but voluntary in others, both patterns normalized in recovering from the shock caused by the COVID-19 pandemic.

In this third stage of the organizational resilience process, discussions about the long-term impact of the COVID pandemic started to surface. Some educators saw new opportunities to developing teaching practices, as experiences with virtual teaching had made them understand how digital resources could be used to meaningfully transcend established lecture formats. As a full professor speculated: "There are some courses where we could use a stock of recordings. Columbus still discovers America in the same year, so it doesn't change very much from semester to semester." Others found meaning in written assignments that had originally been meant as a substitute for general synthesizing discussions, as an assistant professor noted: "They had to write two pages for me, and that counted as active participation. It actually worked well. It was nice for me to get that feedback from the students." As such, experiences with virtual teaching began to challenge previously taken-for-granted assumptions about teaching. One associate professor

reflected on how now-collapsed structures had previously constrained her ability to experiment with new lecture formats: "There is something about the structures. When we plan the semesters, the secretaries automatically book 90-minute slots in auditoriums … It's as if that structure dictates that we need to have standard lecture formats. I tried to say, 'Well, can I not just get a 45-minute lecture?' but met with resistance. It is more flexible in virtual format."

However, educators had different perceptions about the opportunities and challenges of virtual teaching. As the spring semester ended, the immediate onset of the shock receded into the background and critical voices were increasingly raised against virtual teaching. Though educators had successfully shifted to virtual teaching in response to the lockdown, what one assistant professor called the "wow effect" dissipated. Dialogue and fluid interactions between educators and students were perceived as significantly more challenging in the virtual setting, as an associate professor noted: "Although breakout rooms and Teams channels can do a lot, the good exchange and reflection from a physical classroom easily disappears in the stark technological environment of virtual teaching." Student experiences with virtual teaching were likewise mixed. Although students reported positive learning experiences, the majority still preferred physical teaching, as the survey results attested (Appendix C). Yet, many students valued pre-recorded lectures and saw them as ideal in preparing for tests. A graduate student explained: "I've taken two exams, where we could use this pre-recorded material. The fact that you can go back to it is fantastic. It has really helped me a lot if there was something that I had to recall from the lecture when studying for the exam."

Hence, this stage of the resilience process reveals how virtual teaching was normalized to the point where critical debate about its opportunities and challenges took center stage. Still, bringing digital resources into use and change teaching practices when needed, had been crucial for educators as they recovered from the shock. While the initial focus was on pivoting and adapting to the available digital resources, it had now moved to assessing the organizational resilience experience as part of shaping the university's future use of digital resources for teaching as stated by the vice dean: "In this semester we tried out different technologies and approaches for virtual teaching and improved some things. As we have been through that stage, we can now focus more on increasing teaching quality going forward."

5. Discussion

Our study extends emerging scholarly work by applying a process view of organizational resilience (Linnenluecke, 2017; Tim, Cui, & Sheng, 2021; Williams, Gruber, Sutcliffe, Shepherd, & Zhao, 2017) to investigate the under-explored role of digital resources in shaping the process. Drawing on a digital resourcing perspective (Deken et al., 2018; Feldman, 2004; Linnenluecke, 2017), we analyzed how teaching at Aalborg University shifted to a virtual format in response to the government-imposed lockdown during the COVID-19 pandemic. On the one hand, we were fascinated by how educators, assisted by students, managers, and IT personnel, swiftly leveraged digital resources to form new teaching practices amid an exogenous shock. On the other hand, the organizational resilience process was far from straightforward, but loaded with challenges and lurking tensions as virtual teaching practices changed and became more normalized during the 2020 spring semester. In the following, we draw on the findings from this case study to discuss our empirical and theoretical contributions to the literature on organizational resilience and digital resources, and the implications of our contributions to theory and practice.

5.1. Organizational resilience and digital resources

As visualized in Fig. 1, our empirical analysis reveals how the organizational resilience process unfolded as educators pivoted, adapted, and normalized into teaching virtually in response to an exogenous
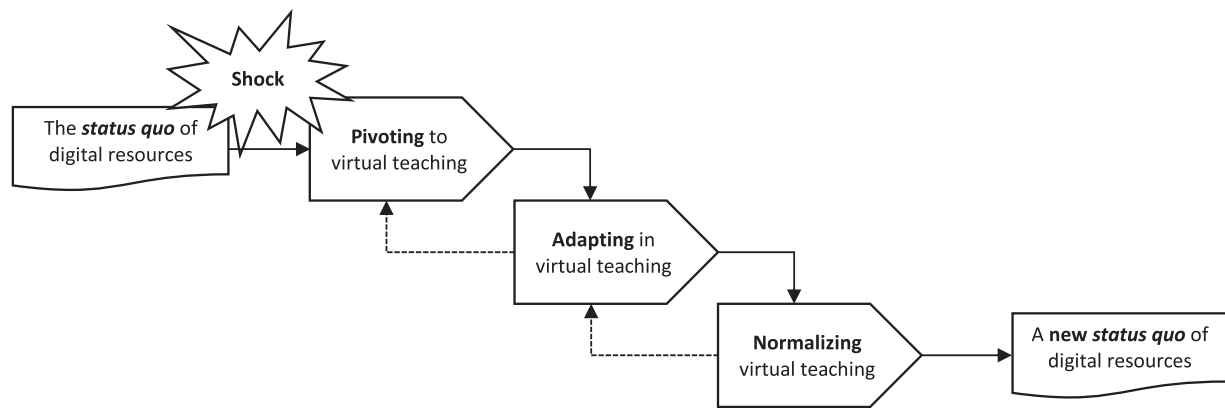
Fig. 1. : Leveraging digital resources to shift to virtual teaching in response to an exogenous shock.

shock that made on-campus teaching impossible. In this process of going virtual, digital resources were crucial and took on specific roles across the three stages as the resilience process propelled the organization forward from the pre-shock accumulation of digital resources to a new status quo, which became the basis for its continued digitalization efforts. While the identified stages differ in focus, they are closely interrelated and together they represent how actors, in the course of the organizational resilience process, continuously interacted with the environment to leverage digital resources (Williams et al., 2017).

Pivoting refers to the stage immediately after the shock were educators spontaneously leveraged digital resources to continue teaching during the government-imposed lockdown. Educators were quick to go virtual by leveraging readily available digital resources, thereby avoiding disruption in the quickest and easiest way possible, for example, using PowerPoint's voice-over functionality to pre-record and distribute lectures. This response, which entailed an immediate change in how teaching was performed, was neither planned nor particularly strategic, but resonates with recent findings clarifying how entering "survival mode" leads actors to keep risks as low as possible by seizing digital resources to replicate preexisting practices in the new environment (Carugati et al., 2020). Hence, as going virtual was the recovery strategy at the university, pivoting captures how select pre-shock accumulated digital resources were activated to keep functioning amid the exogenous shock (Linnenluecke, 2017).

Adapting is the stage in which educators moved away from "survival mode" and deliberately adapted virtual teaching practices to make them more acceptable. While educators were quick to embrace PowerPoint with voiceover, they soon ascertained that pre-recorded lectures could not afford the immediate interaction with and feedback from students that were integral to their pre-pandemic teaching practices. Such concerns led educators to seek ways to improve virtual teaching and engage with more interactive approaches, for example, by adopting MS Teams, Zoom, and other tools and by developing an amalgam of lecture videos, voiceover recordings, live-streaming, and written assignments. This insight unveils how educators moved the resilience process forward by adapting the emergency teaching practices to turn setbacks into meaningful input (Bechky & Okhuysen, 2011). While the pivoting stage was chaotic and characterized by the spontaneous use of readily available resources, the adapting stage was more reflective with deliberative efforts to form "revised, novel, or alternative practices" (Orlikowski & Scott, 2021, p. 5) that were more acceptable for the actors involved. As a result, the educators widened their digital option repertoire (Sandberg et al., 2014) by starting to integrate asynchronous and synchronous technologies to improve virtual teaching.

Normalizing describes the stage wherein educators at the end of the 2020 spring semester described virtual teaching as "a new normal," representing how teaching practices—in a relatively short timeframe—had undergone a fundamental transition. Once the educators

experienced virtual teaching as acceptable, their orientation shifted from shock response to applying virtual teaching with increasing routinization, but also with individual reflections and growing debate over the challenges of virtual teaching. These depictions are in line with recent research indicating that the final stage of resilience is not one of returning to some pre-shock state, but one of moving towards a new status quo (Williams et al., 2017). Our insights pertaining to the normalization stage therefore cast the "new normal" (Carroll & Conboy, 2020) in a different light, underscoring that the university's recovery cannot reasonably be equated to bouncing back to previous teaching practices, but rather as moving forward towards new practices, supporting a process-based rather than an equilibrium-based view of organizational resilience. Based on these insights, we suggest the following:

Proposition 1.   In response to exogeneous shock, an organization can progress through stages of pivoting, adapting and normalizing into digitally transformed work practices, where pivoting involves unplanned activation of available digital resources, adapting involves deliberate adaptation of the emerging digitalized practices, and normalizing involves moving forward towards new digitalized practices.

Our findings also show that digital resources took on different roles across the three stages during which the university responded to the exogenous shock by going virtual. During pivoting, digital resources enabled a swift transition to virtual teaching reflecting how the university initially absorbed the shock to keep functioning by activating readily available resources (Vogus & Sutcliffe, 2007). In this process, educators immediately turned select digital resources into resources-in-use (Deken et al., 2018) and relied on their experiences and skills in using digital technologies from before the pandemic to get their teaching done when on-campus teaching became impossible due to the lockdown. During adapting, digital resources offered flexibility towards acceptable teaching practices as educators learned from their initial responses to turn their virtual teaching experiences and skills into more acceptable teaching practices (Williams et al., 2017). Hence, digital resources were adapted to emerging situation-specific challenges (Boh et al., 2023), emphasizing their malleable attributes in use (Melville et al., 2004; Kallinikos et al., 2013). Finally, during normalizing, which involved a critical discussion of the opportunities and challenges of virtual teaching, digital resources made new digital options for teaching actionable (Sandberg et al., 2014) thereby laying a foundation for future-oriented transformations (Lengnick-Hall et al., 2011). While most university settings have returned to in-person, on-campus teaching of the type that was dominant before the lockdown, the intensive use of virtual teaching during lockdown offered the university thorough insights into different options for integrating (or not integrating) virtual teaching into future teaching practices (Rapanta et al., 2021). Accordingly, we suggest the following:

Proposition 2. Digital resources play different roles in responding to exogenous shock across the stages of organizational resilience: during pivoting, digital resources enable swift transformation into digitalized work practices that allow for continued operation; during adaptation, digital resources offer flexibility that support developing more acceptable digitalized practices; and, during normalizing, digital resources make new digital options actionable that support continued digitalization efforts.

Overall then, the university's response to the exogenous shock became intertwined with the unfolding digitalization efforts. Though organizational resilience is post-shock-oriented (Williams et al., 2017), the response at the university hinged on carrying the past into the present (Pike et al., 2010) by relying on digital resources that were readily available before the shock. As a result of several years of increased focus on digitalizing its operations, the university had accumulated a diverse portfolio of digital resources before the pandemic and this became essential for going virtual when needed. At the Danish university—and at many other higher education institutions (Carugati, Mola, Plé, Lauwers, & Giangreco, 2020; Park, Son, & Angst, 2023)—the decision to make all teaching virtual could only be implemented quickly because actors could activate requisite digital resources from the university's established digital infrastructure, in spite of the fact that virtual teaching had been sporadic before the pandemic. While this resonates with prior research on the importance of pre-shock resource endowments for resilience (Gittell et al., 2006; Lengnick-Hall et al., 2011; Williams et al., 2017), it also illustrates how shock responses necessarily intercept and redirect a long, ongoing process of digital resource accumulation. Interestingly, many of the digital technologies (e.g., voiceover in PowerPoint and MS Teams) that ended up playing a crucial role in the shift to virtual teaching had not previously been used for teaching. These findings highlight that a "digital resource is not a self-contained unit with fixed meaning and relations" (Henfridsson et al., 2018, p. 90), but rather a malleable entity in use (Kallinikos et al., 2013). Moreover, the findings reveal that it was as much people—in our case educators assisted by students, managers, and IT personnel—as technologies that took center stage in the university's response to the exogenous shock (Melville et al., 2004). Hence, we propose the following:

Proposition 3. As an organization leverages digital resources in response to exogenous shock, organizational resilience intertwines with the organization's ongoing digitalization efforts, by depending on the organization's pre-shock status quo of digital resource, by building on and contributing to these resources during the resilience process, and by subsequently leveraging the new status quo of digital resources as part of the organization's continued digitalization efforts.

5.2. Implications for theory

Our study contributes to extant literature by advancing and empirically substantiating a process view of the role of digital resources in organizational resilience. Our empirically grounded model (Fig. 1) encompasses a process unfolding between a pre-shock status quo and a new post-shock status quo through three recovery stages—pivoting, adapting, and normalizing—with shifting roles of digital resources across stages. Although scholars have recognized that the organizational resilience process covers a number of stages (Lengnick-Hall et al., 2011) and have stressed the importance of resource mobilization (Hillmann & Guenther, 2021), most IS research has, hitherto, attended to resilience as outcome (Heeks & Ospina, 2019) and, therefore, still lacks clarity on how resilience comes about and what role is played by digital resources in this process (Boh et al., 2023). Against this backdrop, our study contributes a multi-stage process model of organizational resilience that emphasizes the crucial and shifting role of digital resources in enacting an effective response to exogenous shock.

The process-based view that underlies our contributions highlights the emergent nature of the organizational resilience process (Williams et al., 2017) and illuminates the importance of digital resources accumulated pre-shock. An exogenous shock is per definition unexpected and unfolds rapidly, but it is at the same time invariably situated along an organization's long-term change trajectory (Davoudi, 2012), which enables and constrains the shock response, as shown in this case study. Though established literature on organizational resilience underscores the importance of building resource endowments pre-adversity (Linnenluecke, 2017; Williams et al., 2017), our study demonstrates how actors can swiftly leverage readily available digital resources when needed. Rather than import pre-defined disaster plans, organizations can utilize occasions of disturbance as openings for different materializations of their work and progressively enact novel combinations of digital resources (Henfridsson et al., 2018). By explicating these dynamics, our study illustrates the crucial role of digital resources in shaping organizational resilience in response to exogenous shock.

Our contribution to the literature on resilience and digital resources is substantiated by going virtual as recovery strategy at a university, which made is possible to examine a setting in which the phenomenon of interest—digital resources in the resilience process—was highly present (Pettigrew, 1990). Still, there were other resources involved relating to, notably, culture and routines. For example, as indicated in our analysis, routinized organizational practices (Feldman & Pentland, 2003) about "good teaching" from before the onset of the shock inspired how educators organized and performed their virtual teaching. While digital resources in this way were combined with other resources in the organizational resilience process (Williams et al., 2017), there are distinct attributes of digital resources that distinguish them from non-digital organizational resources (Kallinikos et al., 2013), which made them particularly relevant when the government-imposed lockdown during the COVID-19 pandemic ruled out on-campus teaching. In the university case, the attribute of enabling the virtualization of teaching and completely substituting face-to-face interactions was decisive for keeping the organization functioning during lockdown. In this way, digital resources were instrumental in performing tasks that otherwise would have remained impossible to execute.

5.3. Implications for practice

Our study is relevant for the growing debate about resilience and digital resources and offers several insights for managers. While the implications discussed below might relate to many organizations, they might relate most directly to organizations that are comparable in nature to higher education institutions—such as universities—and other knowledge-intensive organizations which depend on the expertise of highly skilled employees.

First, the case demonstrates that much can be gained from leveraging existing digital resources to recover from an exogenous shock by rapidly establishing new ways of working. Organizations face a severe challenge when they respond to exogenous shock under urgency and time-pressure. Hence, rather than look outward for new digital technologies when faced by an exogenous shock, managers should start by looking at what is ready-at-hand and encourage novel combinations of available digital resources to adjust and maintain functioning.

Second, our findings highlight the important role of individual- and group-level digital autonomy in times of exogenous shock. We recommend harnessing responsiveness by having diverse actors come together in the organization's response to exogenous shock. The case study sheds light on how educators, assisted by students, managers, and IT personnel, learned and experimented to take advantage of digital technologies, ultimately enabling them to perform their tasks under vastly different circumstances. Hence, stressing an alternative to rather elaborate disaster-planning and risk-mitigation protocols, we encourage managers to actively support self-organizing individuals and groups who can recombine existing practices, experiences, and apply digital resources to sustain continuity in their work when disruptive events occur.

Third, managers can benefit from our empirical grounded model (Fig. 1) to help understand the role of digital resources in the organizational resilience process and to anticipate the different stages that their organization will undergo to transform work practices if an exogenous shock occurs. This may help managers understand and identify appropriate response strategies to recover from a disturbance (Carugati et al., 2020). Specifically, we encourage managers to pay closely attention to the different and shifting roles of digital resources during pivoting, adapting, and normalizing that allowed for continued operation at the university when they faced a government-imposed lockdown during the COVID-19 pandemic.

Fourth, and of particular relevance for managers at higher education institutions, the experiences from the COVID-19 presents a learning opportunity to improve and reshape teaching methods in a long-term perspective. While the immediate learnings from a shock response may easily vanish when employees return to old working routines, managers should nurture the long-term impacts and help facilitate further learnings about how to meaningfully combine virtual teaching methods with established lecture formats.

5.4. Limitations and future research

Notwithstanding the aforementioned contributions, our work has its limitations. First, the foundation for our process model is a single-case study and further research is needed to extend its applicability. In advancing further insights, our study can best be generalized to organizational resilience processes that are based primarily on digital resources, like organizations that rely on going virtual as recovery strategy. Studies of other higher-education organizations are encouraged, as are theoretical refinements in contexts driven by different objectives, ranging from public settings to private firms and nonprofit organizations. Likewise, some characteristics of the pandemic do not necessarily generalize to other exogenous shocks, such as natural disasters that could jeopardize the technological infrastructure needed for activating digital resources. Hence, both the character of the case organization's work (knowledge-intensive operations) and the nature of the disturbance (a pandemic suspending physical activity) are important boundary conditions for what can be learned from our study in the context of organizational resilience and digital resources.

Second, while we have shown that pre-shock accumulated digital resources played a crucial part in the university's response to exogenous shock, we encourage scholars to investigate more fully how organizations can prepare digital resources suitable for responding to future shocks (Boh et al., 2023). In a similar vein, although we discerned evidence of work practices normalizing toward the end of the examined time span, we did not assess the long-term implications of the exogenous shock. Hence, further research is needed to probe how the short-term dynamics between organizational resilience and digital resources may evolve over time.

6. Conclusion

Given that prior research offers little insight into the role of digital resources in the organizational resilience process amid an exogenous shock, we sought to advance knowledge in this domain grounded in a case study of how a university shifted to virtual teaching in response to a government-imposed lockdown during the COVID-19 pandemic. As a result, we have detailed how responding to exogenous shock proceeded as organizational actors leveraged digital resources to pivot, adapt, and normalize into teaching virtually, and how digital resources took on specific roles across these stages as the resilience process propelled the organization forward from the pre-shock accumulation of digital resources onto its continued digitalization efforts. We hope researchers and practitioners find that these insights provide an illuminating depiction of the role of digital resources in the resilience process, and how recovery options are dependent upon and impact an organization's unfolding digitalization trajectory.

CRediT authorship contribution statement

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the design, data collection analysis, writing, or revision of the manuscript.

Declaration of competing interest

None.

Acknowledgements

Appendix A. Interview protocol

Background information on interviewees
a) Name Age
b) Current position, department, and education *[Educators, managers, & IT personnel]*
c) Area of study, department, and semester of study *[Students]*
d) Personal attitude towards digitalization: what does digitalization and remote teaching mean to you?

Theme #1: How was teaching delivered prior to lockdown?
a) Please describe your general teaching and student-supervision practices before COVID-19 *[Educators]*
b) Could you describe how teaching and supervision were conducted within your program prior to COVID-19? *[Students]*
c) Which, if any, digital resources did you regularly rely on prior to COVID-19?
d) How would you describe the university's digitalization process up until COVID-19? *[Managers]*
e) Could you describe how teaching and supervision were conducted within your department prior to COVID-19? *[Managers]*
f) Which digitalization initiatives were you working on prior to lockdown, and how did the lockdown change this? *[Managers & IT personnel]*

Theme #2: How was teaching delivered during the lockdown? Which teaching activities were reconfigured for virtual delivery, and how?
a) Could you describe your teaching practices during the COVID-19 lockdown? *[Educators]*
b) Please describe how teaching was conducted within your program during the pandemic *[Students]*
c) Which digital resources did you regularly rely on during lockdown as compared to before? For what did you need them?
d) How did you adapt your teaching and supervision practices to a purely virtual format? *[Educators]*
e) How has lockdown affected the transition to virtual teaching?

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  f) How did you experience the rapid transformation of teaching into virtual form? Was there anything that surprised you?

  g) Were any areas easier or more challenging from your perspective?

  h) Have you been able to identify any trends in how teaching was made virtual? Are there any software systems or teaching methods that are more popular? *[Managers & IT personnel]*

  i) Is there anything you would like your professors to do differently when teaching and supervising? If so, what and why? *[Students]*

  j) How do you find digital interaction with students to differ from face-to-face interaction?

  k) How has digitalization affected your job as a manager? *[Managers]*

  l) Are there certain tasks for which you now prefer a digital format? If so, which ones and why?

Appendix B. Educator-survey results

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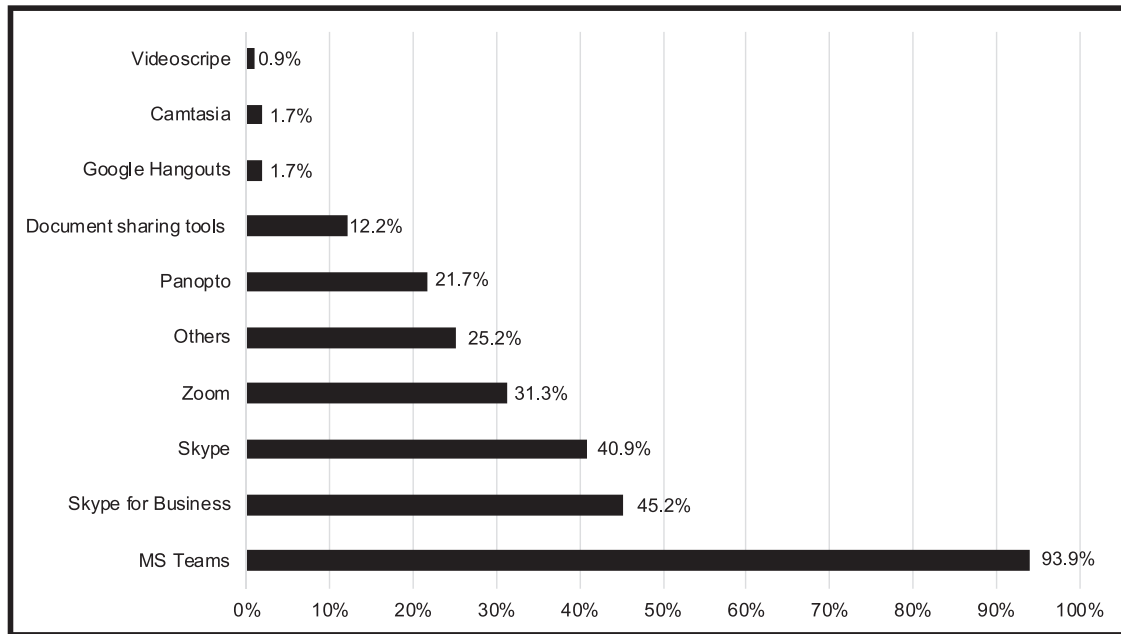
   Digital technologies used by educators for virtual teaching, June 2020 (*n* = 115).

Appendix C. Student-survey results[3]

Type of teaching	Participation in this type of teaching	Positive learning experience	Negative learning experience	Preference for online mode	Preference for traditional mode
Live-streamed lectures	74%	54%	20%	23%	62%
Recorded lectures	73%	48%	23%	26%	60%
Online supervision	72%	60%	15%	16%	60%

Students' learning experiences amid the COVID-19 outbreak (*n* = 632)

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[3] "Positive learning experience" covers the survey's response categories "very positive" and "positive." The same applies for "Negative learning experience." The response category "neutral" from the survey is omitted for simplicity of presentation.

Appendix D. Usage of MS Teams

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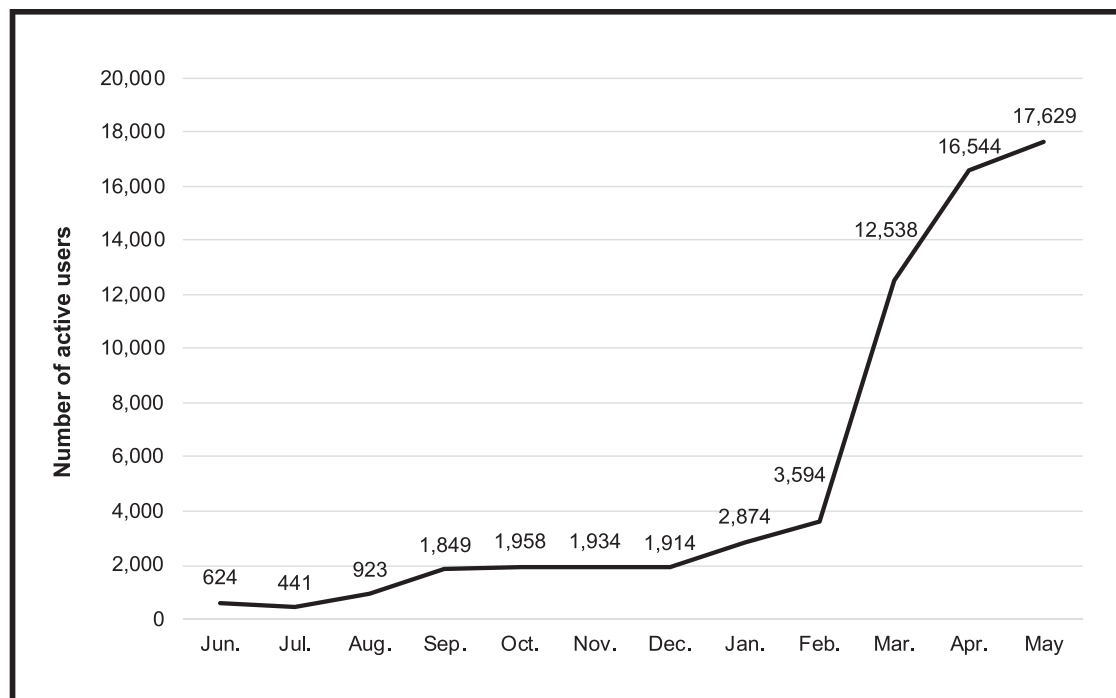
Active MS Teams users from June 1, 2019, to May 31, 2020.

Appendix E. Coding illustrations

Stage	Role of digital resources	Example quotes
Pre-shock	On-campus teaching highly institutionalized with only sporadic attempts at virtual teaching. Digital resources had accumulated because of long-term development toward being a more digitalized university.	"Before lockdown, most experimentation [with virtual teaching] was done by a few committed individuals or junior professors going through mandatory training who wanted to try out some new tools. There is a tendency for most professors to become attached to the traditional lecture format, and once this happens, they have a hard time letting it go." (department manager) "Like my colleagues, I always did my classes on campus before the lockdown." (associate professor) "We have colleagues and students all over the world, so we use Skype a lot. Not for teaching though but for meetings, counselling and filesharing." (associate professor) "[before lockdown] I used Skype for Business quite a lot. To speak with colleagues and for student counselling." (full professor)
Pivoting to virtual teaching	Rapid change of how teaching was performed by going virtual. Use of digital resources readily available to get the teaching done under conditions of high uncertainty.	"This was extreme, compared to anything we had experienced before. We literally changed our teaching practices to virtual format overnight." (dean) "It was wild. I was surprised that it could be done so fast." (full professor) "Early on, people were worried we wouldn't be able to run synchronous virtual teaching because they didn't think we had enough bandwidth." (vice dean) "I learned to use voiceover in PowerPoint. I worked but when it comes to students' engagement it is far from the same as on-campus teaching." (full professor) "I started to create video lectures in Panopto. I knew about it from the mandatory University pedagogical training, but I had never used it. Seemed like a good time to try it." (assistant professor)
Adapting virtual teaching	Adapting virtual teaching practices to make them more acceptable. More deliberate use of various digital resources in attempts to improve virtual teaching.	"As the semester progressed, various forms of virtual teaching were experimented with." (dean) "It has been pretty straightforward with partially synchronous and partially asynchronous teaching. Personally, I had expected more issues. Not because I don't have faith in my staff. I simply thought it would take everyone longer to adapt and that more courses would be postponed or cancelled." (department head) "It is about being willing to push the boundaries of the traditional, comfortable role as educator and turn it into something more experimental." (assistance professor) "Actually, I think MS Teams has been easy to use and better than Power Point slides [with voice over]. It was a lot easier than I expected but the dialogue with the students is still not optimal." (associate professor).
Normalizing virtual teaching	Virtual teaching normalized with critical debate about its opportunities and challenges. Discussion about the future role of virtual teaching.	"While it was very hectic at first, most of us started to get some routine with virtual teaching." (full professor) "Although we succeeded in many ways with virtual teaching, it will never be the same as on-campus teaching." (assistant professor)

(*continued*)

Stage	Role of digital resources	Example quotes
		"We really started to discuss what could be learned from the lockdown. How should we organize teaching in the future?" (full processor) "The opportunity for students to re-hear lectures is certainly something we should learn from. It worked really, well for a lot of students. Even if we go back to physical, face to face, lectures we should still record them and make them available." (associate professor) "When everyone is vaccinated, we can focus on digitalizing of teaching where it makes sense to do so – where it increases quality." (vice dean)

References

Barnes, S. J. (2020). Information management research and practice in the post-COVID-19 world. *International Journal of Information Management, 55*, Article 102175.

Bechky, B. A., & Okhuysen, G. A. (2011). Expecting the unexpected? How SWAT officers and film crews handle surprises. *Academy of Management Journal, 54*(2), 239–261.

Bhagat, S., & Kim, D. J. (2020). Higher education amidst COVID-19: Challenges and silver lining. *Information Systems Management, 37*(4), 366–371.

Boh, W., Constantinides, P., Padmanabhan, B., & Viswanathan, S. (2023). Special issue Introduction: Building digital resilience against major shocks. *MIS Quarterly, 47*(1), 343–360.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal, 9*(2), 27–40.

Butler, B. S., & Gray, P. H. (2006). Reliability, mindfulness, and information systems. *MIS Quarterly, 30*(2), 211–224.

Carpenter, S., Walker, B., Anderies, J. M., & Abel, N. (2001). From metaphor to measurement: Resilience of what to what? *Ecosystems, 4*(8), 765–781.

Carroll, N., & Conboy, K. (2020). Normalising the "new normal": Changing tech-driven work practices under pandemic time pressure. *International Journal of Information Management, 55*, Article 102186.

Carugati, A., Mola, L., Plé, L., Lauwers, M., & Giangreco, A. (2020). Exploitation and exploration of IT in times of pandemic: From dealing with emergency to institutionalising crisis practices. *European Journal of Information Systems, 29*(6), 762–777.

Chatterjee, S., Chakraborty, S., Fulk, H. K., & Sarker, S. (2021). Building a compassionate workplace using information technology: Considerations for information systems research. *International Journal of Information Management, 56*, Article 102261.

Cho, S., Mathiassen, L., & Robey, D. (2007). Dialectics of resilience: A multi–level analysis of a telehealth innovation. *Journal of Information Technology, 22*(1), 24–35.

Cui, M., Qian, J., Dai, X., & Liu, M. (2021). Transition from offline to online through digital resource bricolage in a health crisis: A case study of two primary schools. *Pacific Asia Journal of the Association for Information Systems, 13*(4), 69–96.

Davoudi, S. (2012). Resilience: A bridging concept or a dead end? *Planning Theory & Practice, 13*(2), 299–307.

Deken, F., Berends, H., Gemser, G., & Lauche, K. (2018). Strategizing and the initiation of interorganizational collaboration through prospective resourcing. *Academy of Management Journal, 61*(5), 1920–1950.

DesJardine, M., Bansal, P., & Yang, Y. (2019). Bouncing back: Building resilience through social and environmental practices in the context of the 2008 global financial crisis. *Journal of Management, 45*(4), 1434–1460.

El Sawy, O. A., Malhotra, A., Park, Y., & Pavlou, P. A. (2010). Research commentary—Seeking the configurations of digital ecodynamics: It takes three to tango. *Information Systems Research, 21*(4), 835–848.

Erol, O., Sauser, B. J., & Mansouri, M. (2010). A framework for investigation into extended enterprise resilience. *Enterprise Information Systems, 4*(2), 111–136.

Feldman, M. S. (2004). Resources in emerging structures and processes of change. *Organization Science, 15*(3), 295–309.

Feldman, M. S., & Pentland, B. T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly, 48*(1), 94–118.

Fleron, B., Pries-Heje, J., & Baskerville, R. (2021). *Digital organizational resilience: A history of Denmark as a most digitalized country*. Proceedings of the 54th Hawaii International Conference on System Sciences.

Floetgen, R. J., Strauss, J., Weking, J., Hein, A., Urmetzer, F., Böhm, M., & Krcmar, H. (2021). Introducing platform ecosystem resilience: Leveraging mobility platforms and their ecosystems for the new normal during COVID-19. *European Journal of Information Systems, 30*(3), 304–321.

Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockström, J. (2010). Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society, 15*(4), 20.

Gittell, J. H., Cameron, K., Lim, S., & Rivas, V. (2006). Relationships, layoffs, and organizational resilience: Airline industry responses to September 11. *The Journal of Applied Behavioral Science, 42*(3), 300–329.

Golden-Biddle, K., & Locke, K. (2006). *Composing Qualitative Research*. Sage Publications.

Haslam, C. R., Madsen, S., & Nielsen, J. A. (2021a). Crisis-driven digital transformation: Examining the online university triggered by COVID-19. In D. Schallmo, & J. Tidd (Eds.), *Digitalization: Approaches, Case Studies, and Tools for Strategy, Transformation and Implementation* (pp. 291–303). Springer.

Haslam, C., Madsen, S., & Nielsen, J. A. (2021b). Problem based learning during the COVID-19 Pandemic. Can project groups save the day? *Communications of the Association for Information Systems, 48*(21), 161–168.

Heeks, R., & Ospina, A. V. (2019). Conceptualising the link between information systems and resilience: A developing country field study. *Information Systems Journal, 29*(1), 70–96.

Henfridsson, O., Nandhakumar, J., Scarbrough, H., & Panourgias, N. (2018). Recombination in the open-ended value landscape of digital innovation. *Information and Organization, 28*(2), 89–100.

Hillmann, J., & Guenther, E. (2021). Organizational resilience: A valuable construct for management research? *International Journal of Management Reviews, 23*(1), 7–44.

Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics, 4*(1), 1–23.

Holling, C. S. (1996). Engineering resilience versus ecological resilience. In P. Schulze (Ed.), *Engineering within Ecological Constraints* (pp. 31–44). National Academies Press.

Holling, C. S., & Gunderson, L. H. (2002). Resilience and adaptive cycles. In L. H. Gunderson, & C. S. Holling (Eds.), *Panarchy: Understanding Transformations in Human and Natural SystemsPanarchy: Understanding Transformations in Human and Natural Systems* (pp. 25–62). Island Press.

Hollnagel, E., Woods, D. D., & Leveson, N. (2006). *Resilience Engineering: Concepts and Precepts*. Ashgate Publishing, Ltd,.

Iacono, V. L., Symonds, P., & Brown, D. H. (2016). Skype as a tool for qualitative research interviews. *Sociological Research Online, 21*(2), 103–117.

Ignatiadis, I., & Nandhakumar, J. (2007). The impact of enterprise systems on organizational resilience. *Journal of Information Technology, 22*(1), 36–43.

Kallinikos, J., Aaltonen, A., & Márton, A. (2013). The ambivalent ontology of digital artifacts. *MIS Quarterly, 37*(2), 357–370.

Kvale, S. (2008). *Doing Interviews*. Sage Publications.

Langley, A. (1999). Strategies for theorizing from process data. *The Academy of Management Review, 24*(4), 691–710.

Lengnick-Hall, C. A., Beck, T. E., & Lengnick-Hall, M. L. (2011). Developing a capacity for organizational resilience through strategic human resource management. *Human Resource Management Review, 21*(3), 243–255.

Limnios, E. A. M., Mazzarol, T., Ghadouani, A., & Schilizzi, S. G. M. (2014). The resilience architecture framework: Four organizational archetypes. *European Management Journal, 32*(1), 104–116.

Linnenluecke, M. K. (2017). Resilience in business and management research: A review of influential publications and a research agenda. *International Journal of Management Reviews, 19*(1), 4–30.

Liu, Y., Xu, X., Jin, Y., & Deng, H. (2023). Understanding the digital resilience of physicians during the COVID-19 pandemic: An empirical study. *MIS Quarterly, 47*(1), 391–422.

Márton, A. (2021). Steps toward a digital ecology: Ecological principles for the study of digital ecosystems. *Journal of Information Technology, 37*(3), 250–265.

Masten, A. S., & Obradović, J. (2006). Competence and resilience in development. *Annals of the New York Academy of Sciences, 1094*(1), 13–27.

Melville, N., Kraemer, K., & Gurbaxani, V. (2004). Information technology and organizational performance: An integrative model of IT business value. *MIS Quarterly, 28*(2), 283–322.

Müller, G., Koslowski, T. G., & Accorsi, R. (2013). Resilence-a new research field in business information systems? In W. Abramowicz (Ed.), *Business Information Systems* (Vol. 157, pp. 3–14) Springer.

Nadasdy, P. (2007). Adaptive co-management and the gospel of resilience. In D. Armitage, F. Berkes, & N. Doubleday (Eds.), *Adaptive Co-Management: Collaboration, Learning and Multi-Level Governance* (pp. 208–227). UBC Press.

Omer, M., Nilchiani, R., & Mostashari, A. (2009). Measuring the resilience of the global internet infrastructure system. *2009 3rd Annual IEEE Systems Conference*, 156–162.

Orlikowski, W. J., & Scott, S. V. (2021). Liminal innovation in practice: Understanding the reconfiguration of digital work in crisis. *Information and Organization, 31*(1), Article 100336.

Pandey, N., & Pal, A. (2020). Impact of digital surge during Covid-19 pandemic: A viewpoint on research and practice. *International Journal of Information Management, 55*, Article 102171.

Park, J., Son, Y., & Angst, C. M. (2023). The value of centralized IT in building resilience during crises: Evidence from US higher education's transition to emergency remote teaching. *MIS Quarterly, 47*(1), 451–482.

Patton, M. Q. (2002). *Qualitative Research & Evaluation Methods* (3rd ed.). Sage Publications.

Pettigrew, A. M. (1990). Logitudinal field research on change: Theory and practice. *Organization Science, 1*(3), 267–292.

Pike, A., Dawley, S., & Tomaney, J. (2010). Resilience, adaptation and adaptability. *Cambridge Journal of Regions, Economy and Society, 3*(1), 59–70.

Rai, A. (2020). Editor's Comments: The COVID-19 pandemic: Building resilience with IS research. *Management Information Systems Quarterly, 44*(2), iii–vii.

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2021). Balancing technology, pedagogy and the new normal: Post-pandemic challenges for higher education. *Postdigital Science and Education, 3*(3), 715–742.

Ratten, V. (2022). Digital platforms and transformational entrepreneurship during the COVID-19 crisis. *International Journal of Information Management,* Article 102534.

Riolli, L., & Savicki, V. (2003). Information system organizational resilience. *Omega, 31* (3), 227–233.

Salovaara, A., Lyytinen, K., & Penttinen, E. (2019). High reliability in digital organizing: Mindlessness, the frame problem, and digital operations. *MIS Quarterly, 43*(2), 555–578.

Sambamurthy, V., Bharadwaj, A., & Grover, V. (2003). Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. *MIS Quarterly, 27*(2), 237–263.

Sandberg, J., Mathiassen, L., & Napier, N. (2014). Digital options theory for IT capability investment. *Journal of the Association for Information Systems, 15*(7), 422–453.

Smith, P., Hutchison, D., Sterbenz, J. P., Schöller, M., Fessi, A., Karaliopoulos, M., Lac, C., & Plattner, B. (2011). Network resilience: A systematic approach. *IEEE Communications Magazine, 49*(7), 88–97.

Tim, Y., Cui, L., & Sheng, Z. (2021). Digital resilience: How rural communities leapfrogged into sustainable development. *Information Systems Journal, 31*(2), 323–345.

Tremblay, M. C., Kohli, R., & Rivero, C. (2023). Data is the new protein: How the commonwealth of Virginia built digital resilience muscle and rebounded from opioid and covid shocks. *MIS Quarterly, 47*(1), 423–450.

Vogus, T.J., & Sutcliffe, K.M. (2007). Organizational resilience: Towards a theory and research agenda. IEEE International Conference on Systems, Man and Cybernetics, Montreal, Canada. https://doi.org/10.1109/ICSMC.2007.4414160.

Walsham, G. (2006). Doing interpretive research. *European Journal of Information Systems, 15*(3), 320–330. https://doi.org/10.1057/palgrave.ejis.3000589

Williams, T. A., Gruber, D. A., Sutcliffe, K. M., Shepherd, D. A., & Zhao, E. Y. (2017). Organizational response to adversity: Fusing crisis management and resilience research streams. *Academy of Management Annals, 11*(2), 733–769.

Yin, R. K. (2009). *Case Study Research: Design and Methods* (4th ed.,). Sage Publications,.

Zobel, C. W., & Khansa, L. (2012). Quantifying cyberinfrastructure resilience against multi-event attacks. *Decision Sciences, 43*(4), 687–710.