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## Article

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# Managing the strategic readiness of industrial companies for digital operations

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## ABSTRACT

This study focused on how the strategic readiness of companies for digital operations is managed. The empirical evidence was derived from case studies on 11 industrial companies. The study's findings show that most of the studied companies face challenges in adjusting their digital operations. In response, we propose that to facilitate strategic readiness for digital operations, companies should find a balance between intuitive and data-based decision making; develop leadership capabilities related to strategic development, technology adoption, and culture creation; find a balance between their own and customers' readiness and willingness to accept digital operations; and increase inter-organizational collaboration in the use of digital technologies to allow for simultaneous upgrading of all partners' strategic readiness for digital operations. This study is among the first to examine the strategic readiness of companies for digital operations by attempting to determine how digital operation can be integrated effectively into daily practice.

## 1. Introduction

Current operations management literature agrees that digital technologies affect or will affect every industry, changing the ways that companies operate (Gölzer & Fritzsche, 2017; Li, 2020; Sebastian et al., 2017; Sousa-Zomer, Neely, & Martinez, 2020). In almost all industries, companies have conducted initiatives related to digital operations to seek ways to develop and digitalize their business operations, exploit their benefits, and respond to the challenges of the competitive environment (Chanas, Myers, & Hess, 2019; Matt, Hess, & Benlian, 2015; Zangiacomì, Oesterle, Fornasiero, Sacco, & Azevedo, 2017). For companies to remain competitive, the flexibility and adaptability of their business operations to economic and technological change are emphasized (Gölzer & Fritzsche, 2017). As a result, the readiness of companies to adjust their operations to the adoption of novel digital technologies has become increasingly important to achieve competitiveness.

Emerging digital technologies enable a new way of formulating company operations (Li, 2020; Olsen & Tomlin, 2020). In this sense, digital operations refer to supporting a company's processes through digital technologies (Boute & Van Mieghem, 2021). These may include analytical, blockchain, cloud, and Internet of Things technologies, along with different types of platforms or three-dimensional printing, autonomous vehicles, mobile applications, and so on (Li, 2020; Olsen &

Tomlin, 2020; Vial, 2019; Zangiacomì et al., 2017). The best technology/digital tool or combination of tools for a certain company varies from case to case, since concrete goals are required to underpin implementation (Tabrizi, Lam, Girard, & Irvin, 2019; Ukko, Nasiri, Saunila, & Rantala, 2019). The use of technologies is also influenced by the company's attitude toward new technologies and its ability to take advantage of them (Matt et al., 2015; Vial, 2019). Thus, supporting a company's operations with digital technologies can be regarded as a strategic issue with a significant impact for different business functions and operations, extending even outside company borders and influencing business processes, products, production, supply chains, and sales channels (Horlach, Drews, Schirmer, & Böhm, 2017; Matt et al., 2015).

Strategic readiness for digital transformation and operations itself is not separately identifiable among company operations because it comprises distinct processes within a company. According to Porter (1996), strategy is a unique and purposeful combination of resources designed for "deliberately choosing a different set of activities to deliver a unique mix of values." Digitalizing company operations necessitates taking into account various structural factors, such as management, people, organizational culture and structure, and industry readiness, needed to support change and achieve value through these initiatives (Galindo-Martín, Castaño-Martínez, & Méndez-Picazo, 2019; Konopik, Jahn,

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Schuster, Hoßbach, & Pflaum, 2022; Sousa-Zomer et al., 2020; Tabrizi et al., 2019). Supply chain and customers are no exception, as digital transformation affects both people and networks as well as their communication and working habits (Agrifoglio, Cannavale, Laurenza, & Metallo, 2017; Büyükoçkan & Göçer, 2018; Hausberg, Liere-Netheler, Packmohr, Pakura, & Vogelsang, 2019). Thus, the dimensions of strategic readiness comprise processes that are a crucial practice for fostering, measuring, and strengthening digital operations. The dimensions that comprise digital operations are grouped into five major elements: strategy, management, organization and culture, customers, and supply chain. These dimensions have been built up from the literature on digital transformation to build a theoretical framework that highlights the dimensions through which a strategic level of readiness for digital operations is formed. Thus, the preceding dimensions tend to exist, to some degree, within companies with high strategic readiness for digital operations.

While the influence of digital transformation on companies' operations is widely recognized, its influence on the management of digital operations from strategic perspectives has elicited scant attention. Presumably, digital operations exert a meaningful effect on management activities and their alignment with the strategic objectives of a company. More precisely, the phenomenon of the digital transformation of operations is acknowledged in literature, but little research has been conducted on how operations management from strategic perspectives can assist it. Some strategic issues need to be tackled in order to assist companies in making effective initiatives toward digital operations. Thus, this study investigates how the strategic readiness of companies for digital operations is managed. The study can be classified as a theory-generating case study, as the dimensions of companies' readiness for digital operations are guided by existent theoretical considerations, but the findings are informed and shaped by empirical analysis.

The paper proceeds as follows. The next section provides a literature review of prior research on key concepts and strategic dimensions of digital operations. Different maturity and readiness models, frameworks, and roadmaps in the context of digital transformation are reviewed to determine the dimensions of strategic readiness for digital operations. This study aims to develop a research framework that demonstrates the type of strategic readiness that contributes to the adoption of digital operations in the context of digital transformation. Next, the research methodology is presented to justify the chosen approaches and then empirical evidence is presented based on case studies with 11 companies. For the discussions, the results section is used to create propositions that theorize the contribution of this paper with regard to the role of managing strategic readiness for digital operations. The paper ends with the conclusions and recommended directions for further research.

## 2. Strategic readiness for digital operations

### 2.1. Key concepts

#### 2.1.1. Digital transformation

Emerging digital technologies affect strategies and operations through industries (Li, 2020). Digital transformation is the transformation caused by utilization of digital technologies (Hess, Benlian, Matt, & Wiesböck, 2016). It is a multifaceted phenomenon (Tekic & Koroteev, 2019) that enables the development of new or enhanced products and services and creates changes in the company's vision, strategy, business model, organizational structures, processes, capabilities, and culture (Gurbaxani & Dunkle, 2019). It has different aspects and implications for different companies, as the use of novel digital technologies, such as social media, mobile technology, and analytics, can facilitate substantial business improvements, including improving customer experience, increasing operational efficiency, and creating new business models (Fitzgerald, Kruschwitz, Bonnet, & Welch, 2014; Tekic & Koroteev, 2019).

#### 2.1.2. Digital operations

Digital transformation, considered a multidimensional umbrella term, is directly connected to the use of technology, including analytical, blockchain, cloud, and Internet of Things (IoT) technologies, as well as various types of platforms (Vial, 2019), and is increasingly being adopted by companies to facilitate operations. Digital operations are related to operational level action in the corporate realm because they are related to technology that handles digital inputs and outputs; either humans can act as tool users or an organization's core operations can be fully technology-based (Salovaara, Lyytinen, & Penttinen, 2019). Thus, digital operations refer to supporting a company's processes, in part or in full, through digital technologies (Boute & Van Mieghem, 2021), which an organization uses to realign its current environment by modifying its business and operations (Besson & Rowe, 2012; Matt et al., 2015; Vial, 2019). Boute, Gijsbrechts, and Van Mieghem (2022) defined a digital operation as "a process with a digital workflow," which means that all information required to perform functions, such as work instructions and data, is digitized, allowing information transparency and sharing between various actors. Corver and Elkhuizen (2014) noted that by digitizing operations through automation, standardization, and global sourcing, improves companies' agility and responsiveness to changes and provides better opportunities to grow and maintain profitability. Thus, companies reshape their operations through digital operations; digital technology adds value by making products, services, and processes better, faster, cheaper, or more convenient (McGrath & McManus, 2020).

The ability of companies implementing digital operations to adopt novel digital technologies has become increasingly important for achieving competitiveness. Managing digital operations is challenging because of their complexity and uncertainty (Li, 2020; Tabrizi et al., 2019). Leaders believe that digital technology can make business and operations more efficient, but they are also frustrated with the difficulty of achieving results from novel digital technology (Fitzgerald et al., 2014). Digital technology alone does not add much value to a company's operations without a connection to the company's strategic visions and goals (Davenport & Westerman, 2018; Kane, Palmer, Nguyen-Phillips, Kiron, & Buckley, 2017; Matt et al., 2015; Tabrizi et al., 2019). Berman (2012) noted that companies should refocus on the strategic development of customer value propositions and improve their operational models by using digital technologies. In addition, Warner & Wäger (2019) reported that digital transformation often leads to large-scale changes in a company's collaborative approach, which, when properly implemented, will lead to profound changes in organizational culture. To support their business and operating model, culture, and collaborative networks, companies need new kinds of capabilities to facilitate digital operations in digital transformation (Vial, 2019; Warner & Wäger, 2019).

#### 2.1.3. Strategic readiness

Digital transformation and implementing digital operations can be seen as a strategic issue that incorporates the leverage of new digital technologies, creates new digital business models, and enables new ways to generate value (Matt et al., 2015; Tabrizi et al., 2019). In line with previous studies, Tekic and Koroteev (2019) stated that the digital transformation strategy should take into account utilization of digital technologies and readiness of the business model for digital operations. Digital technology often has major implications for various areas of business, extending outside company borders and influencing business processes, products, production, supply chains, and sales and service channels (Horlach et al., 2017; Matt et al., 2015). Such implications and transformations require companies to adopt a strategy that connects their digital technologies and operations (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013).

Strategic readiness is a state of permanent, organization-wide preparedness for comprehensive and systemic change (Koh, Prybutok, Ryan, & Ibragimova, 2006; Redding & Catalanello, 1994). As digital

technology has significant implications for current and future business, it is important to assess the company's overall readiness to leverage these in the context of the company's business objectives. Thus, this study defined strategic readiness for digital operations as a state of permanent, organization-wide preparedness for comprehensive and systemic change toward implementing digital technologies. However, strategic readiness for digital operations is not separately identifiable among company operations, as it comprises distinct processes within a company. We suggest that strategic readiness dimensions comprise processes that are a crucial practice for fostering, measuring, and strengthening digital operations. These dimensions are introduced next and form the research framework for managing digital operations.

2.2. Research framework for managing digital operations

Facilitating the management of digital operations is an important goal for most modern businesses (Kane et al., 2017); therefore, it is important to determine the type of strategic readiness that contributes to the adoption of digital operations in the context of digital transformation. Through their own activities, companies can promote the use of digital technologies that can result in major improvements in offerings and customer satisfaction, thereby strengthening organizational efficacy (Tortorella, Vergara, Garza-Reyes, & Sawhney, 2020). The management of digital operations from strategic perspectives will support the process of implementing digital technologies to exploit their benefits (Horlach et al., 2017; Li, 2020; Matt et al., 2015; Vial, 2019). Kane et al. (2017) reported that technology has only been one part of the whole, as changes in the capabilities, culture, and organizational structure of a company are needed to achieve business benefits.

With extant operations management studies having paid scant attention to how companies manage strategic readiness for digital operations, a need exists to review empirical studies in other research fields and seek views on the dimensions of companies' strategic readiness for digital operations. Thus, we studied 19 different maturity and readiness models, frameworks, and roadmaps in the context of digital transformation, Industry 4.0, and smart manufacturing to determine the strategic dimensions of industrial companies' digital operations (Appendix 1). Maturity models are generally employed as a tool to conceptualize and measure an organization's maturity or a process in relation to desired goals (Schumacher, Erol, & Sihm, 2016). In this study, digital maturity is the process of adapting company practices in a competitive digital environment (Kane et al., 2017). Using this analysis, five main top-level dimensions were selected: strategy, management, organization and culture, customer, and supply chain. The dimensions were organized such that the first three were interrelated with the last two. This is reflected in the fact that when the first three dimensions, which represent internal readiness, are in order, they serve the last two dimensions, which represent external readiness. These dimensions were used to build a theoretical framework that highlights the mechanisms that companies should focus on to succeed in digital transformation. For companies to effectively leverage digital technologies in their operations, the following dimensions must be considered (Table 1). Thus, the following factors tend to exist, to some degree, within companies with high readiness for digital operations in digital transformation.

2.2.1. Strategy

Integrating digital transformation into a company's strategy is an important success factor in digitalizing operations and adopting digital technologies (Akdil et al., 2018; Chanias et al., 2019; Kane et al., 2017; Pessl et al., 2017). Digital business strategy is not separate but needs to be linked to corporate strategy and other functional and operational strategies (Chanias et al., 2019; Matt et al., 2015). According to Chanias et al. (2019), digital business strategy is a dynamic process that involves learning and doing and is implemented by leveraging digital resources to create a different value. An important part of shaping a digital strategy is setting goals to clarify what is to be achieved and what is less

Table 1  
Research framework for managing digital operations.

Dimensions	References	Factors	References
Strategy	Lichtblau et al., 2015; Berghaus & Back, 2016; Schumacher et al., 2016; Klötzer & Pflaum, 2017; Pessl, Sorko, & Mayer, 2017; Akdil, Ustundag, & Cevikcan, 2018; Büyükoçkan & Göçer, 2018; Mittal, Romero, & Wuest, 2018; Schumacher, Nemeth, & Sihm, 2019; Williams, Schallmo, Lang, & Boardman, 2019	objectives, measures	Lichtblau et al., 2015; Berghaus & Back, 2016; Schumacher et al., 2016; Jung, Kulvatunyou, Choi, & Brundage, 2016; Klötzer & Pflaum, 2017; Lee, Jun, Chang, & Park, 2017; Pessl et al., 2017; Akdil et al., 2018; Büyükoçkan & Göçer, 2018; Schumacher et al., 2019
		Investments	Lichtblau et al., 2015; Mittal, Romero, & Wuest, 2018; Akdil et al., 2018
		Resources	Schumacher et al., 2016; Gökalp, Şener, & Eren, 2017; Pessl et al., 2017; Schuh, Anderl, Gausemeier, Ten Hompel, & Wahlster, 2017; Akdil et al., 2018; Schumacher et al., 2019
Management	Berghaus & Back, 2016; Jung et al., 2016; Schumacher et al., 2016; Gökalp et al., 2017; Lee et al., 2017; Pessl et al., 2017; Akdil et al., 2018; Mittal, Romero, & Wuest, 2018; Schumacher et al., 2019; Williams et al., 2019	Support and willingness to change	Berghaus & Back, 2016; Schumacher et al., 2016; Gökalp et al., 2017; Schumacher et al., 2019
		Digital skills/capabilities	Schumacher et al., 2016; Gökalp et al., 2017; Pessl et al., 2017
		Data-based decision making	Gökalp et al., 2017; Schuh et al., 2017; Mittal, Romero, & Wuest, 2018; Schumacher et al., 2019
Organization and Culture	Corver & Elkhuizen, 2014; Berghaus & Back, 2016; Geissbauer, Vedso, & Schrauf, 2016; Jung et al., 2016; Schumacher et al., 2016; Gökalp et al., 2017; Klötzer & Pflaum, 2017; Pessl et al., 2017; Schuh et al., 2017; Büyükoçkan & Göçer, 2018; Williams et al., 2019	Learning culture and willingness to change	Schumacher et al., 2016; Klötzer & Pflaum, 2017; Pessl et al., 2017; Schuh et al., 2017
		Information sharing	Schumacher et al., 2016; Pessl et al., 2017; Schuh et al., 2017
		Flexible working	Corver & Elkhuizen, 2014; Berghaus & Back, 2016; Pessl et al., 2017; Schuh et al., 2017
Customers	Corver & Elkhuizen, 2014; Berghaus & Back, 2016; Schumacher et al., 2016; Schumacher et al., 2019; Büyükoçkan & Göçer, 2018	Digital information and communication channels Digital capabilities	Corver & Elkhuizen, 2014; Berghaus & Back, 2016; Akdil et al., 2018 Schumacher et al., 2016; Schumacher et al., 2019 Mittal, Romero, & Wuest, 2018;

(continued on next page)

Table 1 (continued)

Dimensions	References	Factors	References
Supply chain	Geissbauer et al., 2016; Büyüközkan & Göçer, 2018	Customer participation and collaboration	Schumacher et al., 2019
		Willingness to change	Schumacher et al., 2019
		Digital capabilities	Geissbauer et al., 2016; Büyüközkan & Göçer, 2018; Schumacher et al., 2019
		Supply chain management	Akdil et al., 2018; Büyüközkan & Göçer, 2018
		Cooperation networks	Corver & Elkhuizen, 2014; Berghaus & Back, 2016; Klötzer & Pflaum, 2017; Schuh et al., 2017; Akdil et al., 2018; Büyüközkan & Göçer, 2018

important (Büyüközkan & Göçer, 2018). Companies also need to define the required capabilities (Geissbauer et al., 2016; Schuh et al., 2017) and measures to monitor changes in the operations (Berghaus & Back, 2016; Pessl et al., 2017; Schuh et al., 2017). Companies of all sizes need to invest in digital-related capabilities to remain competitive (Kane et al., 2017). Therefore, the availability of financial and technical resources is an important factor of digital operations (Mittal, Khan, Romero, & Wuest, 2018).

### 2.2.2. Management

Ultimate comprehensive digital transformation is hardly possible without the willingness of management to change and play a supporting role (Akdil et al., 2018; Gökalp et al., 2017; Pessl et al., 2017). A positive relationship exists between digital strategy and operations management, as reflected in how management supports digital operations and defines roles, responsibilities, goals, and performance indicators for the implementation process (Berghaus & Back, 2016). Thus, the managers who are operationally responsible for digital strategy should have sufficient strategic capabilities and experience from transformational and technological projects (Matt et al., 2015). In addition to management's willingness to change and the company's digital capabilities, rapid decision making also plays a key role in exploiting technological opportunities (Warner & Wäger, 2019). Data-based decision making can make the decision-making process more efficient by producing faster and better results compared to relying merely on the experiences and intuitions of an individual (Mittal, Romero, & Wuest, 2018; Schuh et al., 2017). Furthermore, fast data-based decision making enables strategic agility, which plays a key role when operating in an environment of uncertainty (Warner & Wäger, 2019). However, Ukko, Saunila, and Rantala (2020) highlighted the role of relational mechanisms in the management context, where management should focus on behavioral factors alongside technical ones. Thus, focus should be on management in terms of design and data analysis but should also engage humans in the process (Ukko et al., 2020).

### 2.2.3. Organization and culture

The organizational structure and culture of companies must support digital operations and the use of novel digital technologies (Akdil et al., 2018; Pessl et al., 2017; Geissbauer et al., 2016; Mittal, Romero, & Wuest, 2018; Corver & Elkhuizen, 2014; Kane et al., 2017; Warner & Wäger, 2019). Schuh et al. (2017) defined two main dimensions of culture as a key enabler of agility: willingness to change and social collaboration. Büyüközkan and Göçer (2018) noted that if a company's culture opposes change, the result could be a divided organization in

which one group is moving toward the future while the other remains in the traditional past, thereby hindering digital operations. Pessl et al. (2017) noted that high maturity levels concerning the desire to learn help create an environment that cultivates and encourages learning, in which digital transformation can be integrated more easily. Digital transformation has revolutionized how companies and individuals share information and collaborate with one another (Berman, 2012; Büyüközkan & Göçer, 2018; Leyer, Richter, & Steinhüser, 2019; Tortorella et al., 2020). Digital technology also changes how employees work, for instance, by enabling flexible working from home or on the move. Through new mobile platforms, employees can work anytime, anywhere, and on any digital device (Berghaus & Back, 2016; Corver & Elkhuizen, 2014). With digital operations, in which information sharing is efficient and more flexible forms of work take place, the company requires a culture of trust that supports the desire to share information openly and allows employees to work independently.

### 2.2.4. Customers

Digital operations also extend to the customer (Akdil et al., 2018; Corver & Elkhuizen, 2014; Schumacher et al., 2016, 2019). Berman (2012) indicated that companies should focus on two main issues: reshaping customer value propositions and transforming operations through digital technologies for better customer interaction and collaboration. Digital operations enable deeper collaboration between customers and companies in which, for example, customers can offer opinions and suggestions for the development of operations and products through various digital channels (Agrifoglio et al., 2017; Corver & Elkhuizen, 2014). Communication and information sharing with customers are also strengthened through new digital channels (Berman, 2012; Büyüközkan & Göçer, 2018). Schumacher et al. (2016, 2019) mentioned customers' competence related to digital technology and media as one item of the customer dimension and their maturity models. Customers' digital capabilities play an important role in enabling them to take advantage of new digital information and communication channels, including companies' digital products and services. The willingness of customers to change likewise impacts the company's digital operations (Büyüközkan & Göçer, 2018) and is a significant factor of the customer dimension.

### 2.2.5. Supply chain

In addition to customers, suppliers and partners who are affected by digital transformation must also be integrated during the early stages of the process of implementing digital technologies (Akdil et al., 2018; Büyüközkan & Göçer, 2018; Pessl et al., 2017; Schuh et al., 2017). Companies cannot change their operations alone but need the right suppliers and partners to cope with digital transformation (Moore, 1996; Senyo, Liu, & Effah, 2019). The supply chain needs to focus on enhancing its digital-related capabilities while developing its operations (Büyüközkan & Göçer, 2018). Measuring supply chain performance and managing the digital operations of the supply chain play significant roles in this process (Büyüközkan & Göçer, 2018; Klötzer & Pflaum, 2017). Digital operations enable supply chain partners to cooperate more closely (Corver & Elkhuizen, 2014). Furthermore, the digital supply chain can make a wide range of information available and support collaboration and communication with digital platforms (Büyüközkan & Göçer, 2018; Schuh et al., 2017; Vial, 2019). These digital platforms and collaboration tools allow supply chain employees to efficiently share documents, ideas, contacts, experiences, and information, thereby providing added value (Corver & Elkhuizen, 2014).

## 3. Methodology

In recent years, digital transformation has become one of the most important issues for changing companies and their operating environments. New emerging technologies and various technological components create new business opportunities that differ from traditional

requirements and support a company's existing operations by facilitating the automation of work (Boute & Van Mieghem, 2021; Warner & Wäger, 2019). The present study examines the digital operations of companies through case studies. To assist with the management of digital operations, certain common characteristics should be determined. Thus, this research aims to examine the strategic readiness of companies for digital operations. We pursued the objective of this study through the research question below:

*How is the strategic readiness of companies for digital operations managed?*

We utilized a qualitative case study approach (Eisenhardt, 1989) to examine the strategic readiness of companies for digital operations. Owing to the nature of this study, the case study approach was deemed appropriate in terms of timeliness and significance of the phenomenon in practice (Yin & Yin, 2018). Our approach emphasized the real-world context in which phenomena occur and offered a review of complicated behavioral processes that cannot be easily exposed by quantitative data (Eisenhardt & Graebner, 2007). In addition, based on Yin and Yin (2018), one criterion for conducting a case study was the researcher's admission to a position that was not available previously in the literature. Specifically, this study can be classified as a theory-generating case study, as it considered that existent theoretical considerations guide the dimensions of companies' readiness for digital operations, but empirical analysis informed and shaped the findings (Ketokivi & Choi, 2014).

### 3.1. Case selection

Following Yin and Yin (2018), this study examined multiple cases involving small- and medium-sized enterprises (SMEs) and large companies. Multiple cases were used owing to their potential to provide higher external validity compared with single cases (Voss, Tsiriktsis, & Frohlich, 2002). Carefully selected cases were used to link theory and practice and allow comparison and replication within and between cases, providing a broad understanding of the studied phenomenon (Yin & Yin, 2018). Altogether, 11 companies were used as cases for managing digital operations and selected based on the following inclusion criteria:

- 1) The companies must be involved in concrete initiatives to implement digital operations.
- 2) The companies must provide access to relevant information concerning their readiness for digital operations.
- 3) The interviewee/s should be aware of the digital operations of their company in different organizational areas.

All the selected companies operate globally, but they all have their headquarters or a subsidiary based in Finland. The first two criteria were utilized to select the case companies, whereas the final one was used to select proper interviewees. As noted earlier, the study examined the digital operations of companies from a strategic perspective. According to Matt et al. (2015), the digital business strategy covers several operational, functional, and organizational elements. Thus, the third criteria assisted the selection of interviewees in a way that the choice of covering the entire company as the unit of analysis was justified. To obtain a complete picture of the mechanisms through which strategic readiness for digital operations is formed, company representatives from different units, hierarchical levels, and job descriptions were included in the research process. During the research, we allowed more participants from the companies to participate in the interviews to ensure that we obtain the most comprehensive picture of the company's digital capabilities. In some companies, the responsibility for and management of digital operations were mainly handled by one person (e.g., the CEO or the chief digital officer [CDO]), whereas in others it was necessary to select more respondents for the interview to supplement and validate the knowledge of the interviewees regarding the company's strategic readiness for digital operations. Thus, managers from three management levels were interviewed. While their titles may vary, the interviewees

were selected in such a way that information regarding their readiness for digital operations at a strategic level could be obtained. Thus, all the interviewees had rich knowledge concerning different areas of digital operations at their respective companies. Overall, 18 people were interviewed across the 11 companies. Details from the case companies and the interviews are presented in Table 2.

### 3.2. Data collection and analysis

The results of the case study were supported by data triangulation using multiple sources of evidence (Yin & Yin, 2018). Semi-structured interviews were used as the main data source. Background information from companies, such as financial records, was also collected and

**Table 2**  
Description of case companies and interviews.

Companies	Description of company	Size	Number of interviews	Interviewees' roles
Company A	Operating in the engineering industry with a subsidiary supplying systems, equipment, and services to the paper and pulp industry.	Large	2	Process Technology Manager, Product Manager (of Automation Department)
Company B	Operating in the welding industry by designing, manufacturing, and selling welding equipment and related expert services.	Large	1	Chief Digital Officer
Company C	Operating in a technology industry and delivering customized technology solutions and maintenance services.	Large	2	Production Manager, Factory Manager
Company D	Operating in the engineering industry by designing, manufacturing, and selling plywood and veneer-manufacturing equipment.	Large	1	IT Manager
Company E	Operating in a wood-processing industry by producing and processing cut timber.	Large	3	Development Director, Factory Manager, Project Engineer
Company F	Developing and manufacturing industrial chemicals and floor coverings.	SME	2	Production Manager, Product Development Chemist
Company G	Manufacturing and selling joints for concrete structures and composite beams.	SME	2	Factory Manager, CEO
Company H	Developing, designing, and manufacturing robot technology for object-handling systems.	SME	1	Maintenance Director
Company I	Manufacturing chairs, loungers, and sofas for public spaces and ships.	SME	2	CEO, Product Manager
Company J	Designing and manufacturing clothing.	SME	1	CEO
Company K	Manufacturing of printed plastic packaging.	SME	1	Executive Vice President

analyzed, which impacted case selection and the research design. Moreover, company visits and observations were conducted to collect information on the progress of their digital transformation. These data triangulation efforts helped strengthen the construct validity of the case study (Yin & Yin, 2018).

Data from in-depth semi-structured interviews were gathered between August and November 2019. Individual interviews were used to gain insights from interviewees representing distinct areas of company operations. Interviews were conducted using open-ended questions (Appendix 2) that focused on the dimensions of the conceptual framework proposed in Section 2. Following these predefined dimensions and building interview questions based on them helped ensure the reliability of the data (Yin & Yin, 2018). Given that the topic of company readiness for digital operations is evolving, tentative questions were constructed, but the interview protocol allowed for informal discussions and supporting questions from the researcher. Details from the interviews are presented in Table 2. Each interview lasted between 50 and 90 min. One of the researchers was the only interviewer, which enabled the activity performed to be consistent across cases. The interviewees received transcripts of their interviews, and some interviewees were contacted by email when more information was needed. Finally, validity was ensured by utilizing multiple cases and investigators to analyze the data (Yin & Yin, 2018).

The analysis unit for this study was companies, specifically their strategic readiness level for digital operations. All interviews were recorded—with the interviewees' approval—and later transcribed by a professional service provider. Afterward, additional notes and comments regarding the interviewer's observations were included. Interview data were analyzed using content analysis, with the literature framework (Table 1) as a predefined coding scheme. Transcribed data from the interviews were coded using an iterative process that aimed to filter out and gather relevant information (i.e., prior themes from each interview were recognized). The themes were then placed in appropriate dimensions of the research framework and used to reveal mechanisms for managing digital operations. Other dimensions that were not included in the original dimensions were assessed as well.

Next, within-case and cross-case analyses were performed (Barratt, Choi, & Li, 2011; Eisenhardt, 1989; Yin & Yin, 2018). The within-case results clarified how each company is approaching digital operations and identified the related mechanisms. Cross-case analyses were conducted to allow for replication logic to identify repetitive patterns. This process elicited a description of each strategic readiness mechanism at each dimension. Afterward, an open discussion of the case findings between the three researchers was conducted. Final, the results were analyzed during the discussion until consensus was reached, after which propositions were formed.

**4. Results**

In this study, we attempted to obtain a complete picture of the mechanisms through which a strategic-level readiness for digital operations is formed. The dimensions of companies' readiness for digital operations are guided by existent theoretical considerations (Table 1). The study examined, in more detail, the impact of these five dimensions on a company's readiness to adopt new technologies and practices and guide the development of operations toward becoming more digital. The findings in Table 3 are informed and shaped by empirical analysis of case studies.

*4.1. Readiness of companies for digital strategy*

First, we found that all case-study companies noticed the impact from digital transformation in their industry and utilized it to develop different business areas and operations. Digital transformation is reflected in the company's internal operations, new digital products and services to customers, more efficient production, and supply chain.

**Table 3**  
Research propositions influenced by highlighted factors and research results.

Propositions	Factors	Description; readiness for digital operations	Value for research
P1 Finding a balance between intuitive and data-based decision making facilitates strategic readiness for digital operations.	Strategy: objectives, and measures; investment Management: data-based decision making, digital capabilities Organization and culture: information sharing	Awareness of the importance of digital transformation has increased. Companies have more digital projects and have considered digital transformation in their strategy or have a digital strategy, along with clear objectives and measures to monitor them. Management can utilize digital transformation to support management (e. g., building competence to form a digital strategy), utilize data to support decision making, and develop operations. When investing and building digital operations, management is data- and information-based, and the company utilizes various information-sharing channels and tools, systematic data collection and documentation, and open access for all information users. Trust-based information sharing is likewise fostered in companies to prevent misuse and ensure effective data-driven decision making.	In digital transformation, data-based decision making can serve as a useful tool for operations management; however, engaging humans in the process allows companies to fully benefit from digital operations. Thus, companies should pay attention to their strategic readiness in terms of digital strategy, management capabilities, and organizational structures and culture to facilitate decision-making in digital transformation.
P2 Managerial capabilities related to strategic development, technology adoption, and culture creation facilitate the strategic readiness for digital operations.	Strategy: objectives, and measures; investment, resources Management: support and willingness to change, digital skills/capabilities Organization and culture: learning culture and willingness to	The company is aware of the need for digital competence in management and the new opportunities brought by digital transformation to develop management. Management has a clear desire for digital	Keeping operations unchanged without regular digital renewal leads to the likely failure of the organization in its operating environment. Thus, digital transformation emphasizes strategic

(continued on next page)

Table 3 (continued)

Propositions	Factors	Description; readiness for digital operations	Value for research
	change, flexible work	transformation and can utilize digital transformation to support management (e. g., building competence to form a digital strategy), utilize data to support decision making, develop digital operations, and so forth. The company has more digital projects and has considered digital transformation in its strategy and/ or has a digital strategy, along with clear objectives and measures to monitor them. Investments to digital operations are also linked to digital strategy, and resources have been allocated for development projects. This is reflected in the culture, where the company has a desire to try and develop and is looking for solutions to how things could be done better. There is a culture of continuous development and innovation, which supports new ways of working.	readiness of management to adapt and understand new technologies and integrate them into digital strategy, goals, performance indicators, and decision-making. Management leadership and enthusiasm makes it easier for the rest of the organization to embrace cultural changes that facilitate the success of digital operations.
P3 Responsiveness toward customers significantly impacts strategic readiness for digital operations: Companies should strike a balance between their own and customers' readiness for and willingness to accept digital operations.	Customer: digital information and communication channels, digital capabilities, customer participation and collaboration, willingness to change	The company has increased the participation of customers in development projects and is moving to more customer-oriented development, where cooperation with customers is continuous, and the customer is committed to digital operations. Digital information and communication channels are used	Companies that are strategically adapted to digital transformation and utilize digital operations managed from strategic perspectives (P1 and P2) have the strategic readiness to generate a new type of value for customers. When generating new value through digital operations, customers' participation, capabilities, and

Table 3 (continued)

Propositions	Factors	Description; readiness for digital operations	Value for research
		actively with customers, including social media channels, 24/7 chat, support services, and websites. In addition, the customer has noticed the importance of digital transformation in their operations and wants to be involved in digital operations as well as develop their own skills and functions to be more digital. Customers have begun to develop digital capabilities or have capabilities to use digital products and services as well as digital information and communication channels.	willingness toward digital transformation must be assessed and strengthened.
P4 Increased inter-organizational collaboration in the use of digital technologies allows for simultaneous upgrading of all partners' strategic readiness for digital operations.	Supply chain: digital capabilities, supply chain management, cooperation networks	Companies within their supply chains are beginning to develop digital capabilities supporting the development and utilization of digital initiatives or leverage already a variety of digital initiatives/tools to ensure efficient supply chain management, such as automation, real-time monitoring and control, digital information sharing, and documentation. When developing supply chain operations, the company has started to develop cooperation with various actors to discuss, develop, and test new ideas.	In digital transformation, the inclusion of inter-organizational actors, in which the company is viewed as a network of companies with interconnected performances, facilitates the company's strategic readiness to utilize digital operations. For instance, this includes reductions in resistance to change and an increase in capabilities and resources. Considering propositions P1, P2, and P3, the company's strategic readiness develops toward the readiness to utilize inter-organizational collaboration for the introduction of digital operations.

However, even if companies have some technological or digital initiatives, these do not necessarily constitute a digital strategy.

The results indicated that the companies had set different goals related to digital transformation. For example, Company J's goal was to renew the fit of trousers with the help of artificial intelligence through more efficient use of customer data, thereby improving its customer service. Meanwhile, Company C's long-term goal was to shift to paperless production and enhance information flow between partners through digital tools. We also noticed that only a few companies had an existing digital strategy that would guide the development of their operations toward becoming more digital. However, some companies had a strategy in which digital transformation was reflected partially in the goals and measurement activities of each company. Company B's CDO described the company's digital strategy as follows:

We have long had some level of digitization strategy. When I started this job, of course, I specified it. This is the first CDO job in this company, and our strategy is to understand the customer field and what opportunities are included in digitization in the field. Through that, we will start to produce and modify both the hardware and software services in the direction of how the customer base can be pushed to digitize.

Among the SMEs, only Company J had a digital strategy, even though others had considered the importance of digital transformation in their business operations. The reasons for non-existent digital strategies included the ignorance or strategic incompetence of management, with some managers viewing a digital strategy as unnecessary. Company I described the situation: *"We don't have a strategy. We do these digital purchases when our customers demand them."*

The third aspect of the strategic dimension noticed was that, particularly at SMEs, it was felt that a lack of resources hindered digital initiatives and projects. Specifically, a lack of financial resources was an obstacle to digital operations, and a lack of human resources in development projects hindered digital operations. Within large companies, the deficits of management or employees in capabilities hindered digital transformation. Fourth, the "acquired as needed or upon stakeholder demand" mindset was also highlighted in relation to the digital investment policies of some companies, while at other companies, investments were linked to strategy mindsets.

#### 4.2. Management readiness for digital operations

First, within more digital companies, the desire to digital transformation starts with management, as reflected in the inclusion of digitalization in their strategy, the provision of money for digital projects and initiatives, and the desire for ideas from employees. Company B describes its management attitude as follows: *"Usually, I don't have a problem pushing new ideas to managers. It's actually the opposite. They want more ideas and implementations than we have the ability to deliver."* Unlike companies at the start of the digital transformation route, the desire to change often begins elsewhere, such as upon the request of customers or employees. This situation slows down the digital operations of a company when the company's management is not committed to the change. This is how Company F describes the situation: *"The first willingness to change usually doesn't come from management but from elsewhere, such as employees or customers, and the company's management also sees the benefits only after changes are made."* Thus, management should view digital operations as a positive and a development opportunity, so that it can be used effectively to develop activities.

Second, some companies were increasing data-based decision making while other companies described such decisions as being more intuitive. For example, Company H described how there is a *"clear desire for management to be measure-based management,"* and Company B said its management is constantly seeking new ways to make desired data visible so that these can be used for different needs, such as to support decision making. However, the data must be available, high quality, and

in real time to be exploited, thus requiring the necessary systems. Company K said that its large amount of data is often manipulated to advance agendas: *"I have found out that data are utilized for a lot of abuse."* This situation is reflected in, for instance, how decisions are made first and then specific data are collected to support these decisions. Therefore, information and measures should be transparent within the company to prevent misuse.

The third management element noticed was that all companies described how the digital capabilities of management need to be developed and vary widely among companies. The inability of management to lead a company's digital strategy can be viewed as an obstacle to the company's digital operations. Management must be able to utilize digital transformation to develop the business, possessing the competence to form a digital strategy, define goals and measures, and utilize novel digital tools and data to support management activities and decision making. Management should also be aware of new opportunities and technologies and lead the implementation of a digital strategy.

#### 4.3. Organizational and cultural readiness for digital operations

First, we noticed that companies ready for digital operations have the desire to try and evolve and are looking for solutions to how things could be done better. Company B said, *"We cherish the culture of innovation; we encourage employees to always think about how things could be done better and in a new way."* However, within younger companies, changes tend to be delayed and often made only when necessary. As Company F describes it, *"We're always trying to prolong change, only moving forward out of compulsion, but that culture is changing so that we're a little more receptive to new technology."* Second, we also found that other factors, such as industry, economic situation, and management, influence the culture of change and openness of a company. Some of the companies described themselves and their industries as conservative, with no emphasis on openness and willingness to change, making it difficult to move toward digital operations, as reflected, for example, during the implementation of new digital tools. Unlike companies within technology industries, such as Company H, whose business is to develop, design, and manufacture robot technology for object-handling systems, there is an inherent interest in technology and so new technologies are being received at a lower level. In two SMEs, a change in ownership positively or negatively impacted an organization's openness to digital operations. For example, Company G set out to develop its competitiveness by leveraging new technologies and practices while Company K took some steps backward due to the attitudes of management toward digital operations. Company K noted that its culture has become more conservative due to economic woes.

Third, we studied the information-sharing practices of companies and noticed problems with information sharing among almost all companies. To make information sharing more efficient, companies introduced new digital tools alongside traditional ones. A common digital tool was information screens that displayed information for employees, and others were the Intranet and Microsoft Teams. Company J described utilizing an application that included a "learning environment" for employees within a year, with a work-related information and discussion platform available in one place. Some companies also have increased documentation and transparency of information so that the necessary information is available to employees: *"With these tools, we take care that everything is documented, and others can see it from there if necessary."* The importance of real-time information was also emphasized: *"The intention is to add measures in the future that are visible in real time and may be linked to reward systems."*

We also examined how companies' organizations and cultures support new ways of working. The aspect we noticed was that more digital companies have cultures that were more supportive of remote working. In particular, remote work was encouraged on the expert side. Other forms of work were also common among mature companies, such as

desk sharing, home offices, and remote meetings. Company B described its culture as follows:

Today, remote working is business as usual. In my team, employees keep a remote day at least once a week, as it calms things down when there are fewer interruptions. Then it's time to delve deeper into the job itself. The systems can be accessed at home on a computer and also on most mobile devices.

However, among companies other than the two specified, the culture maintained the attitude that “work is done at work” even if their systems could accommodate working from home. Additionally, few case companies defined general remote work principles.

#### 4.4. Customer readiness for digital operations

First, our research showed that customers with weaker digital capabilities hindered the digital operations of companies. As Company K noted, “*Our customers' digital capabilities vary greatly; for example, we still have 120 customers who do not have e-mail in use.*” There were obstacles to companies' digital operations if customers did not have the ability to participate in the change. The wide variation in customers' digital capabilities also elicited problems when trying to make operations and services more digital:

One of our challenges is that the digital capabilities of our customers (are) highly polarized to these uber users and non-capability users, so the challenge is how to create a system equally for both customer groups without doing extra work (Executive Vice President, Company K).

Second, the willingness of customers to adjust to digital transformation also impacts companies' digital operations. If customers are not willing to take advantage of the digital products and services or information and communication channels that the company offers, then it would be more difficult for the company to leverage these operations. Company K described the situation: “*Our current ERP allows the customer to place an order directly in that system, but our customers may not be ready for it yet.*” The company's use of digital initiatives must meet customers' needs, and even if a company has the know-how and necessary technology but the customer's digital desire is lacking, it would be difficult for the company to take advantage of these digital initiatives. Third, we noticed that customers' willingness to change was influenced by the industry in which they were operating. For example, the construction industry was perceived as a conservative sector. As Company H noted, “*We have customers in so many different industries that they also need to be treated differently. It must also be taken into account in our digital strategy.*”

Fourth, we noticed that some companies made more active use of digital information and communication channels than did other companies. For example, Company B, a digitally developed company, stated that social media channels are important to create a corporate image and information access, and Company C, accustomed to digital operations, thought that an online support channel makes information sharing and conversations with customers more efficient. However, customers require access to these channels to use them effectively. Fifth, our study found that customers should be involved in and collaborate with the company's digital operations. They should be able to engage with change, such as by developing digital channels, products, and services together in a customer-oriented way. As Company E noted:

Increasingly, we want to understand our customers' earnings logic and business environment. It opens up a whole different world and the opportunity to understand different business concepts for the benefit of the customer. For example, our company's digital store is made with customers to make it a success.

#### 4.5. Supply chain readiness for digital operations

First, we noticed how the supply chain was viewed as having many opportunities for digital development. For example, Company E was developing its supply chain by designing an application that seeks to increase the utilization of empty trucks. Looking to the future, companies saw that there was much room for digital initiatives in supply chains. To develop the supply chain, companies need the cooperation of different parties. Second, we found that digital operations of the supply chain emphasized the use of collaborative networks. Company B described this finding as follows: “*Our supply chain's digital operations require partner networks, and the deeper we go into the digitality, the more services we need to complement our expertise, such as data analytics.*” Digital operations of SMEs' supply chains are hindered by a lack of cooperation networks that would support the development of operations with novel digital initiatives. The companies' culture must also support collaboration to enable this kind of development.

Third, we found that within large companies, the digital capabilities of supply chains were greater than those of SMEs. Fourth, we found that some companies ready to implement the digital operations of supply chain used technology more efficiently than did other companies for supply chain management. For example, the technology was utilized in supply chain automation, real-time monitoring and control, digital order placement, and information sharing. Company D described its supply chain automation as follows:

We have a variety of automations involved in the supply chain. For example, buyers can see what delivery dates have been set by suppliers to monitor their fulfillment, production can be tracked for individual pieces, and we also have automatic alert lists in case of any delay in schedules at some point in the process.

Moreover, at the end of the supply chain, companies took advantage of digital initiatives. Company A described how it used real-time tracking of deliveries to monitor the routes that ships and trucks take before they reach customers.

## 5. Discussion

Next, the theoretical and managerial implications of the case findings were discussed. In this matter, the four propositions shown in [Table 3](#) relating to how companies' strategic readiness for digital operations is managed are discussed. The findings show that most studied companies face challenges in adjusting their operations to a more digital one, responding differently to this challenge. Companies have conducted initiatives related to digital operations to seek the ways to develop and digitalize their business operations and exploit their benefits. To succeed in digital transformation and implementing digital operations, digitally developed companies increased their data-based decision making to facilitate the integration of activities into their strategic goals. [Schuh et al. \(2017\)](#) stated that the benefits of digital technology include better information availability and access, which enable more efficient decision making; as well as the transparency of their consequences and alignment with the company's strategic objectives. In addition, [Warner and Wäger \(2019\)](#) reported that when operating in conditions of deep uncertainty, fast decision making is key to seizing technological opportunities and achieving strategic agility. Thus, data-based decision making can serve as a useful tool for operations management in turbulent environment because digital transformation has enabled managers to access data faster than ever ([Gölzer & Fritzsche, 2017](#)). The current study supports this perspective on data-based operations management, as it was viewed as providing accurate and timely information for company management. However, the results show that data cannot be trusted blindly, and that some data interpretation is needed. Therefore, a culture of trust-based information sharing should be embedded within a company to support the use of data so that no misuse occurs ([Sarka, Heisig, Caldwell, Maier, & Ipsen, 2019](#)).

Thus, an intuitive perspective on the management of digital operations should be considered in conjunction with the technical perspective. This notion corresponds with prior research that concluded that in facilitating the management of digital operations, focus should not only be on management in terms of design and data analysis but should also engage humans in the process to fully benefit from digital operations (Tortorella et al., 2020; Ukko et al., 2020). Based on the findings of the present study, some companies rely more on intuitive decision making through lack of planning and systematic actions to manage digital operations, leading to digital initiatives being implemented only when needed or upon stakeholder demand and not as data-driven strategy activities. However, the operating environment is more complex, and there are other influential factors that cannot be controlled; companies cannot cope with intuitive decision making alone. Both intuitive and data-based decision-making approaches were found to have certain benefits and limitations, and neither was enough individually to manage a company's strategic readiness for digital operations.

Digital technologies enable data collection and communication, which allow individuals, teams, and organizations to benefit from such support to exchange information and make decisions more effectively (Gölzer & Fritzsche, 2017; Tortorella et al., 2020). Based on this study's results, the concurrent utilization of intuitive and data-based decision making is highlighted in the strategic readiness for digital operations management (cf. Schuh et al., 2017; Tortorella et al., 2020; Ukko et al., 2020; Warner & Wäger, 2019). Thus, on the basis of this study's findings, we propose the following:

**P1.** Finding a balance between intuitive and data-based decision making facilitates strategic readiness for digital operations.

The findings highlighted the role of managers in managing digital operations in various aspects, such as strategic development, technology adoption, and creation of proactive culture. Our study is in line with Li (2020) and Sousa-Zomer et al. (2020), who stated that management of the transition to new technologies, new strategies, and operation models requires new leadership skills. Managers' capabilities to create a digital strategy were viewed as essential, and the lack of a digital strategy may lead to market failure (e.g., Besson & Rowe, 2012; Matt et al., 2015). The current study shows that the initiatives for digital operations must originate from inside the company, not only from customers or other stakeholders, because a late reaction can make it difficult to succeed in the market. Furthermore, maintaining operations as they are without regular digital renewal leads to the likely failure of the organization in its operating environment (Li, 2020). The findings indicate that a lack of digital strategy may be due to managers' ignorance or incompetence, in which the incompetence regarding novel technologies may lead to a lack of motivation that may hinder movement toward the proactive culture as well as strategy and technological development (cf. Mittal, Khan, et al., 2018; Sousa-Zomer et al., 2020). All these can hinder adapting companies' operations in a competitive digital environment.

The notions above led to the discussion around the capabilities of managers to adapt and understand novel technologies as well as connect them to digital strategy, goals and performance measures, and decision making (cf. Berghaus & Back, 2016; Büyüközkan & Göçer, 2018; Pessl et al., 2017; Schuh et al., 2017; Warner & Wäger, 2019). Understanding technological development is emphasized within those who operate with a lack of financial and human resources (Mittal, Khan, et al., 2018). SME managers need to understand industrial development to invest in the most appropriate technologies without being overheated. To avoid misdirected and oversized investments, managers need to understand both the industry and technology. They also need to be aware of existing digital tools, or at least be aware of how and where necessary skills and competencies can be acquired. Thus, managers should be able to evaluate and manage their companies' digital operations to strike a balance between the readiness of industry, internal and external pressure, technologies, and available resources (cf. Büyüközkan & Göçer, 2018; Kane et al., 2017; Mittal, Khan, et al., 2018; Ukko et al., 2020; Warner &

Wäger, 2019).

Implementing digital operations is also a cultural issue (Kane et al., 2017; Warner & Wäger, 2019). The results of this study showed that managers contributed to change in terms of incorporating digital transformation into strategy, allocating money for digital projects and initiatives, and employees' willingness to offer ideas. In addition, when managers want to evolve, they seek out ideas, implementation, and solutions from employees to understand how things could be done better (Li, 2020; Tabrizi et al., 2019). Such a proactive culture requires new digital tools to make information sharing more efficient and create a proactive learning environment (Büyüközkan & Göçer, 2018; Pessl et al., 2017). However, it also is important to consider that in digital operations, people need to play by the rules because culture is affected by history, environment, and the current situation, which is slow and difficult to change. Managers determine how an organization operates, and with management enthusiasm, it is easier for the rest of the organization to embrace cultural changes that facilitate strategic readiness for digital operations (cf. Chanias et al., 2019). Thus, based on the above, we propose:

**P2.** Managerial capabilities related to strategic development, technology adoption, and culture creation facilitate strategic readiness for digital operations.

The findings of this study demonstrated the importance of customers' role in enabling digital operations. With help from digital technologies, companies could refocus on developing customer value proposition (Berman, 2012) and customer experience (Büyüközkan & Göçer, 2018), leading to better customer interactions and collaboration in digital transformation. The management of digital operations likewise fosters the adoption of digital technology in companies, resulting in major improvements in product and service offerings as well as customer satisfaction (Tortorella et al., 2020). Corresponding with this, and in line with Chanias et al. (2019), the present study revealed that the digital strategy must be formed in a customer-oriented manner, taking into account the capabilities and willingness of customers to accept digital operations. It also showed that companies should be strategically aligned toward digital operations to succeed in complex competitive environments rather than making changes based on customer demands. Digital operations management from strategic perspectives will support the management of the process of adapting companies' practices in a competitive digital environment (Horlach et al., 2017; Kane et al., 2017; Li, 2020; Matt et al., 2015; Vial, 2019).

The findings of this study revealed that barriers to companies' digital operations exist if customers lack the ability and/or desire to participate in the change of operations. In this case, the company must have the capacity to help customers adapt to digital operations and support the development of their digital skills. However, customers should not be forced into using digital operations if they are not ready for it. Corver and Elkhuizen (2014) stated that digital operations enable deeper collaboration between customers and companies. Our study found that customers should be involved in as well as collaborate with the company's digital operations. Customers should be committed to digital transformation; for example, they should have the opportunity to provide feedback and suggestions through digital channels to help develop products and services together with the company in a customer-oriented way, promoting operations management (Agrifoglio et al., 2017; Tabrizi et al., 2019). Thus, customer commitment and cooperation with the company support the management of digital operations. For this reason, the third proposition of this study is as follows:

**P3.** Responsiveness toward customers significantly impacts strategic readiness for digital operations: Companies should strike a balance between their own and customers' readiness for and willingness to accept digital operations.

The findings indicated that digitally developed companies were more active in extending the use of digital technologies with both the

customers and the multi-tier supply chain. Digital information and communication channels are emphasized with customers while supply chain automation, real-time monitoring and management, digital ordering, and information sharing are emphasized in multi-tier supply chains. This development was possible when both customers and the supply chain were involved in collaboration, considering the design and implementation of digital technologies for mutual benefits. These findings strongly supported prior statements that management research on digital technologies focuses on the inclusion of inter-organizational actors in the process, in which the company is not viewed as one company but rather as a network of companies with interconnected performances (Senyo et al., 2019). The findings also showed that collaboration with the supply chain and customers positively influences reductions in resistance to change in conservative industries as well as the capabilities and resources in SMEs. This may have been realized via the enhancement of relational mechanisms, such as inter-organizational trust and know-how development, which facilitate the relationships governed by social interactions that drive inter-organizational management in digital operations (Ukko et al., 2020).

The results emphasized that companies use digital technologies, such as information and communication channels, in a variety of ways together with customers and suppliers. This understanding will enable the purposeful and strategic use of digital operations, in which both the multi-tier supply chain and customers are asked to evaluate the organization and its operations, often using social media and other information technology-enabled platforms (Agrifoglio et al., 2017; Büyükoçkan & Göçer, 2018). Thus, the findings supported the notion that digital transformation of the entire supply chain helps make a wide range of information available, supports collaboration and communication with digital platforms (Büyükoçkan & Göçer, 2018; Schuh et al., 2017), and allows for the evaluation of experiences (Corver & Elkhuisen, 2014). The study shows that companies purposefully are moving toward a more interactive, open, and participatory use of digital technologies to engage the multi-tier supply chain and customers in a conversation about the operations performance and management of collaborative partners (cf. Agrifoglio et al., 2017; Büyükoçkan & Göçer, 2018). Co-evolution in inter-organizational collaboration and digital technologies seems to facilitate the ability to move collectively to more digital-enabled operations (cf. Moore, 1996; Senyo et al., 2019). This means that all partners react and adapt to digital operations simultaneously. Based on this, the following proposition is presented:

**P4.** Increased inter-organizational collaboration in the use of digital technologies allows for the simultaneous upgrading of all partners' strategic readiness for digital operations.

## 6. Conclusions and future research

This study contributes to existing operations management literature in the context of digital transformation. First, the research determines the strategic dimensions and their factors for managing digital operations, namely, strategy, management, organization and culture, customer, and supply chain. These dimensions are suggested to facilitate the readiness of companies for digital operations. Second, identifying the strategic dimensions and factors comprises a contribution to operations management research and helps develop a framework to determine the type of strategic readiness that contributes to the adoption of digital operations in the context of digital transformation. Third, four propositions are presented that relate to how companies' strategic readiness for digital operation is managed.

The findings of this study show that most studied companies face challenges in adjusting their operations in the digital transformation, but they respond to such challenges differently. The main contributions regarding the companies' readiness for digital operations are as follows. Regarding the first proposition, the study contributes to the literature by highlighting the importance of finding a balance between intuitive and

data-based decision making. Intuitive and data-based decision making should be utilized concurrently to facilitate digital operations. Thus, the study contributes to previous research related to digital transformation, which over-emphasizes data-based decision making, by arguing that a suitable balance should be found between intuitive and data-based decision making. Regarding the second proposition, the study contributes by highlighting the role of managers in digital operations in various aspects, such as strategic development, technology adoption, and creation of a proactive culture. The capabilities of managers in adapting and understanding novel technologies and connecting them to digital strategy, goals and performance measures, and decision making are critical in managing digital operations. Thus, the study contributes to the existing literature by highlighting the expanding role of managers in digital transformation.

Transformation into digital operation does not just happen within a company, but instead, the company needs to consider its customers and other stakeholders and partners. Regarding the third proposition, the study states that companies should strike a balance between their own and customers' readiness and willingness to embrace digital transformation. Responsiveness to customers significantly furthers digital operations, and customers' commitment and cooperation with a company support digital operations. Thus, the study contributes to previous research by emphasizing the importance of helping and engaging customers in utilizing digital operations rather than forcing them to implement digital operations. Regarding the fourth proposition, our study contributes by stating that companies should increase inter-organizational collaboration in the use of digital technologies, as it allows for simultaneous upgrading of the maturity of all partners' digital operation. Companies should purposefully move toward a more interactive, open, and participatory use of both digital technologies to engage the multi-tiered supply chain and customers in a conversation about the performance of collaborative partners. Thus, the study contributes to previous research by emphasizing the importance of cooperation to realizing a simultaneous digital leap between partners. If both partners and customers have similar capabilities, the strategic readiness to utilize digital operations will also be at a higher level.

The results of this study are relevant for management practice as well because they highlight the key issues taken into account with digital operations. Furthermore, the study provides suggestions on the determinants of the effective adoption of digital operation (i.e., the dimensions of strategic readiness). Managers need to be aware of existing digital tools, or at least be aware of how and where such skills and competencies can be acquired. Thus, they need to be able to evaluate and manage companies' digital operations to strike a balance between an industry's maturity, internal and external pressures, technologies, and available resources. There can be barriers to the digital operation of companies if customers (or partners) do not have the capabilities or willingness to participate in the process. In this case, the company must have the capacity to help customers adapt to digital transformation and support the development of digital skills without forcing them to change.

The limitations of this study depend on findings from 11 companies, but considering that the research focused on extending existing theory on companies' digital transformation and operation, an in-depth analysis of the limited number of cases was viewed as a suitable approach. It can also be considered as a limitation of the study that only the interview data were used in the in-depth analysis, but other collected data were used to develop a background understanding. Further research could focus on specific industries or multi-tiered relationships to gain deeper insights relating to how strategic readiness for digital operations is managed. More research is also needed on the connection between a specific focus of digital operation (e.g., digital products and services, internal processes, or sales and marketing) and its effect on managing digital operation.

In addition, the study provides broad opportunities for quantitative future research. First, future research could investigate the readiness of

customers and partners for digital operations and its connection to financial success. The starting point of initial hypothesis would be that the higher readiness they have, the better the company's financial performance. Another interesting line of research would be to study the mix of data-based and intuitive decision making, and what is the appropriate balance between these to maximizing success in a company. Finally, managerial capabilities and their effects on different strategic

dimensions could be studied: what kinds of paths can be formed from these capabilities to develop an organization's strategic readiness for digital operations?

### Declaration of Competing Interest

There is no conflict of interest in the manuscript.

## Appendix 1. Digitalization-related maturity models

Research paper	Dimensions	Study perspective
Corver & Elkhuizen, 2014 Lichtblau et al., 2015 "IMPULS Industrie 4.0 readiness"	Products, processes and systems, organization, customer Strategy and organization, smart factory, smart operations, smart products, data-driven services, employees	A framework for digital business transformation Readiness model that classifies six levels of Industry 4.0 readiness
Schumacher et al., 2016 "Industry 4.0 maturity model"	Nine dimensions and 62 items Dimensions: strategy; leadership; customers; products; operations; culture; people; governance; technology	A maturity model for assessing Industry 4.0 readiness and the manufacturing enterprise's maturity
Geissbauer et al., 2016 "PwC maturity model for Industry 4.0"	Digital business models and customer access; digitization of product and service offerings; digitization and integration of vertical and horizontal value chains; data and analytics as core capabilities; agile IT architecture; compliance, security, legal issues, and taxes; organization, employees, and digital culture.	A maturity model for Industry 4.0 capabilities development
Jung et al., 2016 "Smart manufacturing system readiness assessment, SMSRL"	Organizational, IT, performance management, information connectivity	Evaluating smart manufacturing readiness for SMEs and MNEs.
Berghaus & Back, 2016 "Digital Maturity Model, DMM"	Nine dimensions: customer experience; product innovation; strategy; organization; process digitization; collaboration; information technology; culture and expertise; transformation management	Digital maturity model
Schuh et al., 2017 "Industrie 4.0 Maturity Index"	Structural areas: resources; information systems; culture; organizational structure Functional areas: development; production; logistics; services; marketing; and sales	Industry 4.0 maturity index for managing digital transformation
Gökçalp et al., 2017 "Industry 4.0-MM"	Asset management, data governance, application management, process transformation, organizational alignment	Industry 4.0 maturity model
Lee et al., 2017 "A Smartness Assessment Framework for Smart Factories"	Four criteria, 10 sub-criteria, 46 items: Criteria: leadership; process; system and automation; performance assessment	An assessment framework to evaluate smartness for factories
Pessl et al., 2017 "Roadmap Industry 4.0"	Acceptance and application of new technologies and media, professional competence, learning competence, corporate strategy, human resources development strategy, organization and democratization, flexible working models, health and safety, information and communication, employer branding, change management, process orientation, knowledge management	A maturity model capable of evaluating the different areas of development in the field of human resources
Klötzer & Pflaum, 2017 "Digital Transformation Maturity Model for Supply Chain"	Strategic development, offerings to customers, smart factory, complementary IT systems, cooperation, structural organization, process organization, competencies, innovation culture	Maturity model for the manufacturing industry's supply chain
Akdil et al., 2018 "Industry 4.0 Maturity Model"	Smart products and services; smart business processes, strategy, and organization	Industry 4.0 maturity model
Büyükoğuzkan & Göçer, 2018 "Digital Supply Chain Framework"	Digitalization: digitalization strategy; digital organization and culture; digital operations; digital products and services; digital customer experience Technology implementation: project management; human and technology relationship; formation of technology infrastructure; technology enablers Supply chain management: integration; automation; reconfiguration; analytics; process	Digital supply chain development framework
Mittal, Romero, & Wuest, 2018 "SM <sup>3</sup> E Maturity Model"	Five dimensions: finance; people; strategy; process; product Seven toolboxes: manufacturing/fabrication; design and simulation; robotics and automation; sensors and connectivity; cloud/storage; data analytics; and business management	Smart manufacturing maturity model for SMEs
Schumacher et al., 2019 "Industry 4.0 realization model"	Eight maturity dimensions and 65 maturity items Dimensions: technology; products; customers and partners; value-creation processes; data and information; corporate standards; employees; strategy and leadership	Industry 4.0 maturity model and 10-step roadmap for manufacturing enterprises
Williams et al., 2019 "Digital Maturity Models for Small and Medium-size Enterprises"	Strategy, products/services, people and culture, management, processes	Digital maturity model for SMEs.

## Appendix 2. Structure for interview questions

This interview structure clarifies the questions asked during the interviews. The interview structure was designed to concentrate on five strategic dimensions: digital strategy; management; organization and culture; customer; and supply chain. In addition, general questions were asked.

General questions:

1. Please briefly describe your job title and job description at the company.
2. Please identify the department in which you operate and the department's size (if it is a large company).

Questions about the company's strategic readiness for digital transformation:

3. Please describe how your company has taken digitalization into account in its strategy (goals, effects, measures, actions) (digital strategy).
4. Please specify how much and in what areas your company has invested in digital transformation (digital strategy).
5. Please indicate whether your company's current resources support digital transformation (digital strategy).
6. Please describe management's willingness to engage in more digital operations at your company (management).
7. Please describe management's competence in digital strategy, technologies, and opportunities at your company (management).
8. Please outline how the company leverages data in its decision-making processes (management).
9. Please describe how the company views digital change (organization and culture).
10. Please describe how information flows within your company, and specify what kinds of technological tools for information sharing the company uses (organization and culture).
11. Please describe continuous improvement processes and culture at your company, and how digital technologies are part of it (organization and culture).
12. Please describe working practices at the company (flexible work, remote work) and analyze how digital technology is part of it (organization and culture).
13. Please specify what kinds of digital channels your company uses to communicate and share information with customers (customer).
14. Please analyze your customers' digital capabilities (customer).
15. Please explain how the company utilizes customers in business, e.g., to test and develop digital products and services (customer).
16. Please describe how the company leverages digital technology in service processes, sales, and marketing (customer).
17. Please describe how the company leverages customer data through analytics (customer).
18. Please analyze your supply chain's digital capabilities (supply chain).
19. Please describe how the company leverages digital technology in your supply chain (supply chain).
20. Please describe what kind of cooperation you have in your supply chain (supply chain).

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