Leadership for Digitalization and Digital Servitization

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Abstract

Digitalization and digital servitization present substantial opportunities for innovation and growth, particularly for incumbent companies. This cumulative dissertation examines the leadership skills required to leverage these opportunities while managing the associated challenges and complexities. Four overarching research findings emerged by applying the research methods of a literature review on leading internal and external digitalization activities and semi-structured interviews with thirty digital servitization experts. Digitalization and digital servitization leaders should adopt a holistic leadership approach, possess a visionary mindset, focus on change management, and be employee-oriented. Moreover, transformational leadership has been identified as a suitable leadership style for navigating digitalization and digital servitization. The findings of this cumulative dissertation contribute to the scholarly discussion by advancing the underexplored research area of digital leadership and providing actionable insights for practitioners on the required leadership skills to succeed in digitalization and digital servitization.

Digitalisierung und Digital Servitization bieten große Chancen für Innovation und Wachstum, insbesonders für etablierte Unternehmen. Die vorliegende kumulative Dissertation untersucht, welche Führungskompetenzen nötig sind, um diese Chancen zu nutzen und die damit verbundenen Herausforderungen zu bewältigen. Mithilfe eines Literature Reviews und Interviews mit dreißig Expert:innen wurden vier zentrale Erkenntnisse gewonnen: Führungskräfte sollten einen ganzheitlichen Führungsstil verfolgen, visionär denken, sich auf Change Management konzentrieren und mitarbeiterorientiert agieren. Transformational Leadership wurde dabei als besonders geeigneter Führungsstil für Digitalisierung und Digital Servitization identifiziert. Die Ergebnisse dieser kumulativen Dissertation leisten einen Beitrag zum wissenschaftlichen Diskurs in dem bislang unterrepräsentierten Forschungsfeld des Digital Leadership und bieten Führungskräften praxisrelevante Einblicke in die erforderlichen Führungskompetenzen, um Digitalisierung und Digital Servitization erfolgreich zu gestalten.

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1 Introduction

Digitalization and the introduction of digital technologies are among the most influential factors in business and society (Reis et al., 2020), resulting in fundamental changes in how people live and work (Nyagadza, 2022). The associated technological advancements are reshaping and disrupting several industry sectors (Calderon-Monge & Ribeiro-Soriano, 2024; Lang & Lang, 2021). These shifts can be seen as radical innovations leading to transformational changes within industries and companies (Heilemann & Faix, 2023). Thus, many companies across different business sectors explore and exploit opportunities that arise through digitalization initiatives (Matt et al., 2015). The potential range of applying digital components can be manifold within companies' business practices. On the one hand, introducing digital technologies can create new intelligent products, services, or new business models for customers (Kohtamäki et al., 2019). On the other hand, digitalization initiatives provide opportunities to achieve greater internal process efficiencies (Björkdahl, 2020) and data transparency for better decision-making (Vrana & Singh, 2021). Consequently, introducing digital technologies affects large and contrasting parts of companies as they become integrated into the core of products, services, business models, and operations (Tagscherer & Carbon, 2023; Yoo et al., 2012).

Digital transformation is the overarching concept that describes the organizational changes, associated modifications to the value creation, business strategy, and company culture resulting from incorporating digital technologies (Verhoef et al., 2021; Vukšić et al., 2018). These disruptive changes require new ways of thinking within companies, such as restructuring business processes, organizational structures, or employee skill sets (Kraus et al., 2021). However, many companies are not yet fully equipped to face the challenges arising from digital transformation (Almeida et al., 2020). Especially when digital technologies converge with another influential development that industrial companies are undertaking, increasing the level of services in addition to physical products, scholars describe companies lagging behind their expectations (Pham & Vu, 2022). This research stream, called digital servitization, can be described as "generating additional value for the installed base of existing customers by providing product and service bundles enabled by digital technologies through newly created or revised business models" (Tagscherer &

Carbon, 2024). The interplay of the two research areas within digital servitization is underpinned by complexity, a multitude of involved stakeholders (Kohtamäki et al., 2021), and a need for change within the organization (Cimini et al., 2021; Favoretto et al., 2022).

Navigating complexity (Gurr & Drysdale, 2020) and managing organizational change are defined as leadership responsibilities within companies (Kotter, 2000; Nging & Yazdanifard, 2015). Especially within the fast-paced environment and shortened innovation cycles within digitalization and digital servitization (Ashurst et al., 2008), leadership is essential to realize radical innovations (Faix et al., 2020) and managing the high levels of uncertainty within organizations (Kraus et al., 2021; Tagscherer & Carbon, 2023). Despite rising academic interest in linking the topics of digitalization and leadership (de Araujo et al., 2021), existing scientific research lacked a nuanced view of specific digitalization aspects, such as different perspectives and required leadership skill sets. These research gaps built the foundation of the present dissertation and resulted in research questions on how leadership supports succeeding in different digitalization activities.

Starting with the initial objective, the research project investigated the required leadership skills to succeed within companies' different digitalization activities, mainly emphasizing the opposing perspectives of internal and external digitalization initiatives with the help of a literature review. Besides providing a comprehensive overview of leadership skills for digitalization based on extant literature, my research identified that the convergence of the two subjects, digital servitization and leadership, specifically lacked scientific attention so far (Tagscherer & Carbon, 2023). Due to its potential to increase value creation for companies (Paschou et al., 2020), I decided to expand the initial research and address the research gap by focusing on linking digital servitization and leadership. Based on a qualitative study involving thirty semi-structured interviews with leadership experts in the area of digital servitization, I posed the research questions: What are the relevant leadership skills for digital servitization? What is the scope of the leadership role, and what are the affected leadership skill requirements for digital servitization? (Tagscherer & Carbon, 2024) The third research study used insights from the first research study, the literature review on required leadership skills for digitalization, to further detail and specify how to lead digital servitization. Based on a positive correlation between digital transformation and transformational

leadership (Philip, 2021), a specific leadership style that is closely associated with change management (Warrick, 2011) and is described as leading with a clear vision and purpose (Stewart, 2006), the fit of transformational leadership for digital servitization was examined. Furthermore, I elaborated on which elements of transformational leadership support implementing digital servitization activities.

The overarching research topic investigated the required leadership skills for digitalization within companies. The cumulative research evolved from the broader question of required leadership skills for internal and external digitalization activities, which was approached through a literature review. Within the review, I discovered the need to study the specific area of digital servitization and its supporting leadership elements, which was approached with a qualitative and explorative research design.

2 Theoretical background

The following section describes and defines the research's central subjects, digitalization, digital servitization, leadership, and transformational leadership, in the context of their application within the dissertation. The definitions build the baseline for the subsequent section, where I elaborate on existing research findings in the respective fields and outline the identified research gaps.

2.1 Digitalization & Digital Servitization

The development of information technologies allows adding digital components to previously purely physical products (Hirsch-Kreinsen, 2016; Tagscherer & Carbon, 2024). Digital technologies, such as the Internet of Things, cloud services, artificial intelligence, or social media (Mihardjo et al., 2019), enable companies to create new products and business models or redefine existing processes, which is defined as digitalization (Verhoef et al., 2021). The benefits of implementing digitalization activities range from increasing internal process efficiencies to adding customer value and generating new revenue streams (Björkdahl, 2020). The overarching concept that affects the overall business strategy, organizational structures, or company culture based on integrating digital technologies is called digital transformation (Vukšić et al., 2018). The resulting changes can potentially transform companies, industries, and societies fundamentally (Vial, 2019), thus gaining significant scientific attention on successfully implementing digitalization and digital transformation (Reis et al., 2018).

Digital servitization builds on the convergence of digitalization and companies' increased service orientation (Vendrell-Herrero et al., 2017). The concept of servitization was first introduced by Vandermerwe and Rada (1988) and describes adding value to the core product offering through services and providing a fuller market offering through the customer-oriented combination of goods, services, support, self-service, and know-how for the customer (Tagscherer & Carbon, 2024). Opposed to offering single products, servitization provides several advantages, such as more stable revenue streams (Bustinza et al., 2013), increased resistance to economic cycles (Oliva & Kallenberg, 2003), and the potential for improved profit margins (Gebauer et al., 2005). Furthermore, service offerings are more tailored to individual customers (Baines et al., 2009), thus avoiding price-based competition (Baines et al., 2007) and shifting customer relationships from transactional towards a relationship-based collaboration (Oliva & Kallenberg, 2003). Adding digital technologies to develop or refine existing service business models based on the availability of data analytics and real-time information (Tronvoll et al., 2020) is called digital servitization (Gebauer et al., 2021; Paschou et al., 2020) and offers new possibilities to facilitate service innovation (Ardolino et al., 2018). However, despite the potential of digital servitization, scholars describe difficulties in its implementation due to its inherent complexity (Jovanovic et al., 2022; Kohtamäki et al., 2021; Pham & Vu, 2022), requiring transformational shifts (Tronvoll et al., 2020) and an organizational change process (Bustinza et al., 2018).

2.2 Leadership & Transformational Leadership

Although the concept of leadership has been known and researched for decades (Kotterman, 2006), it does not have one unique and universally accepted definition (Yukl, 1998) but changes based on its application and boundary condition (Larjovuori et al., 2018). Following the leadership definition of Faix et al. (2020, p.61): "Leadership means to lead oneself and human communities with personality […] into an innovative and creative future in open and complex situations under unclearly defined and dynamic conditions while always considering the framework conditions and collective rationality." Leaders are why people want to achieve a common goal (Mergenthaler, 2017). They set the direction, motivate, and align people by creating a shared vision (Kotter, 2000; Winston & Patterson, 2006). Therefore, leadership is essential for

enabling innovations, shifting business models, and guiding organizational change (Faix et al., 2020; Mihardjo et al., 2019).

The rising scientific interest in digitalization emerged in the research area of digital leadership and describes the elements of strategic success for the digitalization of enterprises and their ecosystems (de Araujo et al., 2021; El Sawy et al., 2016; Tagscherer & Carbon, 2023). Especially in the context of VUCA, which is an acronym for Volatility, Uncertainty, Complexity, and Ambiguity (Bennett & Lemoine, 2014) and describes today's unstable, dynamic, and rapidly changing business environments (Lawrence, 2013), authors have outlined several attributes positively influencing leadership for companies' digital transformation (Larjovuori et al., 2018). For example, leading digital transformation requires formulating a clear vision (Kane et al., 2019) and fast decision-making (Larjovuori et al., 2018). Furthermore, creating an environment for experimentation (de Araujo et al., 2021), increased risk-taking attitude (Kane et al., 2015), and the willingness to collaborate beyond organizational boundaries within ecosystems are attributes supporting improving companies' digital maturity levels. A central leadership skill for digital leadership is to embrace change and focus on change management (Kane et al., 2019). Due to its close association with change management (Warrick, 2011) and fit for leading times of uncertainty and change (McCleskey, 2014), existing research recommends using a transformational leadership style for navigating digital transformation (Alos-Simo et al., 2017; Matsunaga, 2021; Philip, 2021).

Whereas transactional leadership is suitable for well-ordered and structured times (Brahim et al., 2015) and builds on compliance with the leader, close monitoring, and seeking to maximize efficiency based on clear reward structures (Bass et al., 2003), transformational leaders are often described as charismatic (Avolio et al., 1991), who motivate their employees by setting directions including boundary conditions without detailed instructions. The features of transformational leaders are summarized by the four Is: Idealized influence, inspirational motivation, individual consideration, and intellectual stimulation (Kirkbride, 2006). For example, leaders influence their employees by creating a clear vision and a sense of purpose and acting as role models (Tagscherer & Carbon, 2025). Motivation is achieved through clear and enthusiastic communication. Transformational leaders are interested in employees' individual needs and generate a feeling of being important by considering all

viewpoints and active listening. The final of the four Is, intellectual stimulation, is underlined by fostering creativity and innovation by promoting new ideas and an open-minded way of thinking (Stewart, 2006).

3 Review of existing research and identification of research gaps

Despite the existing scientific research, Faix (2020) called for deepening the understanding of the highly interdisciplinary topics of digitalization and leadership to realize the necessary innovations using digital technologies. My research evolved from addressing a broader research object around digitalization and leadership to the more specific research area of leading digital servitization and the fit of transformational leadership.

Despite an increasing research interest in connecting digitalization and leadership, I identified a need to distinguish between different leadership aspects for digitalization's internal or external dimensions within the growing body of scientific articles. The range of applications for digitalization activities within companies can be very diverse (Loonam et al., 2018). Moreover, the benefits companies strive towards by implementing digital technologies can vary substantially. On the one hand, achieving efficiency gains in administrative processes (Faix et al., 2020), using digital tools to improve collaboration and communication (Guinan et al., 2019), and digitalizing manufacturing processes (Matt et al., 2015). On the other hand, redefining customer value propositions, newly created products or services, or redefined business models (Coreynen et al., 2017; Loonam et al., 2018). Existing scientific research did not address this question but instead focused on how to lead companies within their overarching digital transformation journeys (Tagscherer & Carbon, 2023). I addressed this research gap with a literature review to identify differences and similarities in leadership for internal and external digitalization activities.

The second research paper focused on a specific digitalization activity, digital servitization, and its required leadership skills and traits. Although digital servitization's inherent complexity and calls for support to manage it more effectively within companies have been outlined by extant research (Gebauer et al., 2021; Kohtamäki et al., 2021; Tóth et al., 2022; Tronvoll et al., 2020), existing articles only focus on

certain leadership aspects for digital servitization. For example, Cimini et al. (2021) researched which competencies support succeeding in digital servitization, ranging from technical to leadership skills, but did not specifically focus on leadership skills. Furthermore, Sklyar et al. (2019) focused on organizing the company for digital servitization, a core leadership element. Bustinza et al. (2018) specifically investigated change management and developed a change framework for digital servitization. Despite the previously mentioned research outlining specific leadership skills for digital servitization, the current scientific debate lacks a holistic view of leadership for digital servitization (Tagscherer & Carbon, 2024). This research gap was approached through an explorative research design based on semi-structured interviews.

To further deepen and gain a more specific understanding of how to lead digital servitization, the third research article elaborated on the fit of transformational leadership to digital servitization. The research question emerged based on several aspects. Firstly, transformational leadership attributes positively correlate with digitalization and digital transformation (Alos-Simo et al., 2017; Philip, 2021). Secondly, digital servitization is described as a complex undertaking (Jovanovic et al., 2022; Kohtamäki et al., 2021), requiring visionary leadership (Favoretto et al., 2022; Pham & Vu, 2022; Sklyar et al., 2019; Tronvoll et al., 2020) and change management (Bustinza et al., 2018; Sklyar et al., 2019; Tronvoll et al., 2020) which corresponds to the core strength of a transformational leader (Hay, 2006; Stewart, 2006). Lastly, I followed the call of extant research to increase the understanding of leadership (Gebauer et al., 2021; Tóth et al., 2022) and more specific managerial decision-making models for digital servitization (Paschou et al., 2020; Tagscherer & Carbon, 2024), thus elaborating whether transformational leadership supports transformations towards digital servitization.

4 Methods

The present cumulative dissertation, consisting of three research papers, used different research methods to answer the associated research questions on how to lead digitalization activities. The first research aimed to identify the required leadership skills for internal and external digitalization. Due to the availability of an existing body of research for digitalization and leadership, a literature review was applied as it synthesizes information and identifies patterns based on existing research findings

(Snyder, 2019). Based on the combination of the guidelines provided by Kitchenham and Charters (2007) and Snyder (2019), the research partners planned, conducted, and documented the review. The data collection process used the three databases "ScienceDirect," "Web of Science (Core Collection, All Editions)," and "EBSCO Business Source Ultimate" as they offer multidisciplinary content. The time range of identified articles was from 2011 to 2021. Six search terms associated with digitalization were identified based on reviewing existing research and linked with the Boolean operator "AND" with the term leadership to identify research that contains both research subjects. Furthermore, the approach included the elimination of duplicates, inaccessible articles, and further quality criteria such as English language and unsuitable publication style, and no association with the digital or business context. Lastly, further articles referenced in the search results were added to complement the final set of articles. For the analysis, the research followed an inductive coding process according to Mayring (2000) and the findings were presented based on patterns and themes.

As a lack of existing research linking digital servitization and leadership was identified within the first paper, semi-structured interviews were selected as the research method for the subsequent research. To gain insights into the underexplored research area, I used open-ended questions during the interviews to gain qualitative insights of an exploratory nature (Kallio et al., 2016; Weller et al., 2018). The research participants were identified through purposive sampling. I contacted experts on the research topic based on matching job descriptions on the business network platform "LinkedIn." The research participants' classification into industry background, managerial level, and leadership experience is presented in Table 2 in Paper #2. The interviews were conducted and recorded from April 2023 until July 2023 via Microsoft Teams. The initial transcription was generated through Microsoft Teams' transcription function (Tagscherer & Carbon, 2024). Furthermore, it was manually optimized through intelligent verbatim transcription to enhance readability and ensure the interview partners' statements' correctness (McMullin, 2023). I included a loop after five interviews to assess code saturation, which was reached after thirty interviews (Tagscherer & Carbon, 2024, 2025). The transcripts' analysis was performed following Braun and Clarke's (2006) guidelines for thematic analysis. I reviewed the data inductively, given the exploratory context of the research. After finalizing the coding

process, including refining, structuring, and collating, the results of required leadership skills for digital servitization were presented based on a three-stage thematic map (Braun & Clarke, 2006; Mayring, 2014). Additionally, I addressed the potential researcher bias by an intercoder-check, performed by research partner, to increase the reliability of the research.

As the third research subject, investigating the fit of transformational leadership and digital servitization, targeted a similar group of experts, I used an analogous research approach. Compared to the previous research design on general leadership skills for digital servitization, I differentiated in the areas of interview questions and data analysis to include the aspect of transformational leadership. Based on the paper's inherent review of existing literature on transformational leadership style, the interview questions centered around the four categories of transformational leadership, the four Is (see Section 2.2). However, my questions were still open-ended to allow the participants to provide background information and reasoning details in their responses. The data analysis followed the principles of thematic analysis by Braun and Clarke (2006). However, due to the specific formulation of the interview questions along the transformational leadership characteristics, I applied a hybrid approach including deductive and inductive elements (Boyatzis, 1998; Crabtree & Miller, 1992). On the one hand, the characteristics of transformational leadership counted as a template for counting references from a deductive standpoint. On the other hand, additional aspects that the research participants associated with leading digital servitization were added from an inductive perspective. Additionally, the answers to the question investigating the interview partners' opinion on the opposing leadership style, transactional leadership, were analyzed inductively. The analysis results were presented within a three-stage structure following Gioia et al. (2013), which summarized the codes into themes and dimensions.

In summary, I chose the most appropriate research method to answer the specific research questions of each paper. All three articles followed a similar structure. They started with an introductory section that explains the research topic and outlines the research gap and questions. After that, I presented the theoretical background of the papers' central elements and reviewed extant literature in the context of the present dissertation. Following that, the research methods and the research-specific application were outlined. Subsequently, I presented the results and

discussed them in the context of their implication and existing research findings. Lastly, the research papers offered a conclusion, limitations of the research, and an outlook and recommendations for further research. Figure 1 summarizes each step's main items from the three research papers. The bullet points in bold emphasize the interconnectedness of the cumulative research work by outlining where research results and outcomes of literature reviews were used to identify research gaps and originate research questions.

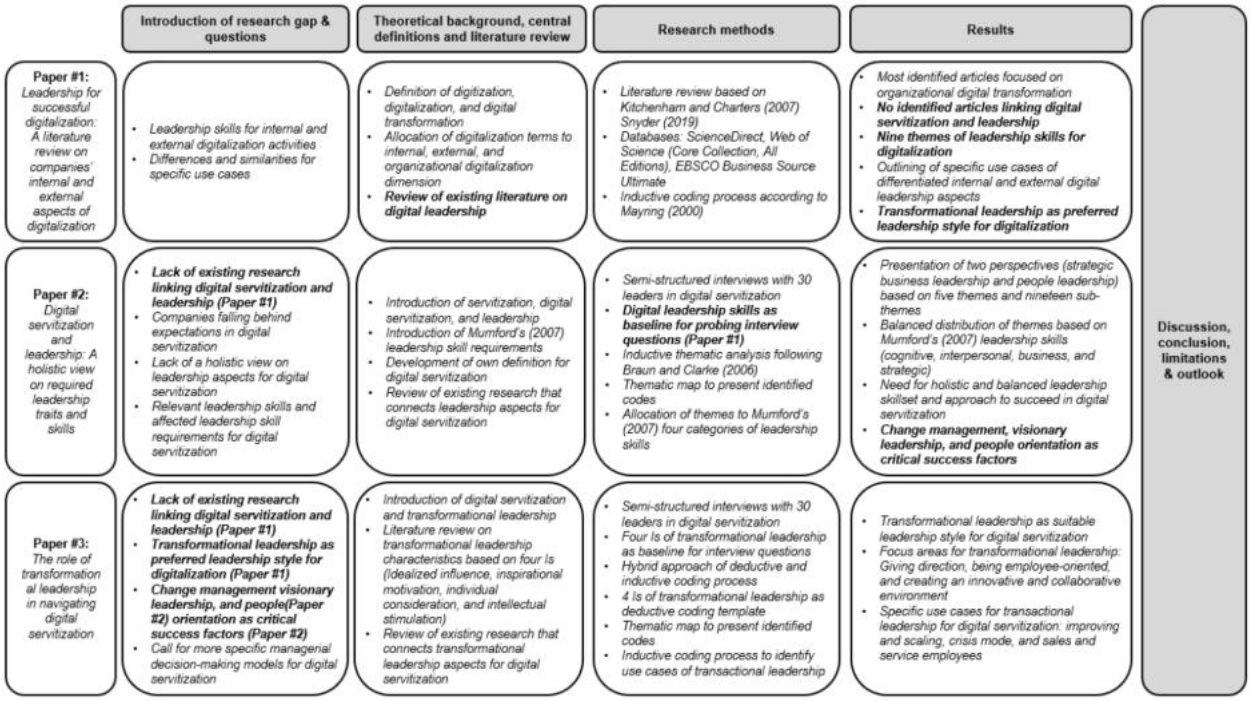

Figure 1: Cumulative research process and interconnection of research papers

5 Results

5.1 Results Paper #1

The following section displays the results of the three researches and their synthesis. The first study elaborated on leadership skills for digitalization through the literature review research method. The research primarily aimed to outline potential differences between the internal and external digitalization dimensions. Following the outlined research approach, the initial database search yielded 1,115 articles. I applied the defined quality criteria and excluded all except sixty articles. Identifying additional articles referenced in the search results led to the final set of 92 articles. The process is depicted in Figure 3 in Paper #1.

The articles' first classification clarified whether their content was related to internal or external digitalization leadership activities. As a significant share of articles did not specifically focus on either dimension, the classification "organization" was introduced to label articles that targeted describing leadership skills for overarching digitalization activities within companies.

Table 1: Paper #1 - Article distribution per dimension (Tagscherer & Carbon, 2023)

Dimension	***N* of articles**	**Percentage**
Organization	57	62%
Internal	23	25%
External	12	13%

According to the distribution, the first insights outlined that most of the articles of existing research focus on the overarching aspect of leading digitalization (62%) compared to the specific internal (25%) and external (13%) dimensions. Furthermore, this analysis provided that the set of articles did not include any research that linked the topics of digital servitization and leadership, which was attributed to the external dimension (Tagscherer & Carbon, 2023). Those insights represent the foundation of further research in subsequent papers.

The research's main findings originated following inductive analysis and were presented based on themes and associated aspects. Furthermore, outlining specific internal and external aspects per theme provided further details associated with the general research object of leadership skills for internal and external digitalization (see Table 2 in Paper #1). In total, nine themes were derived as findings, presented in Figure 2.

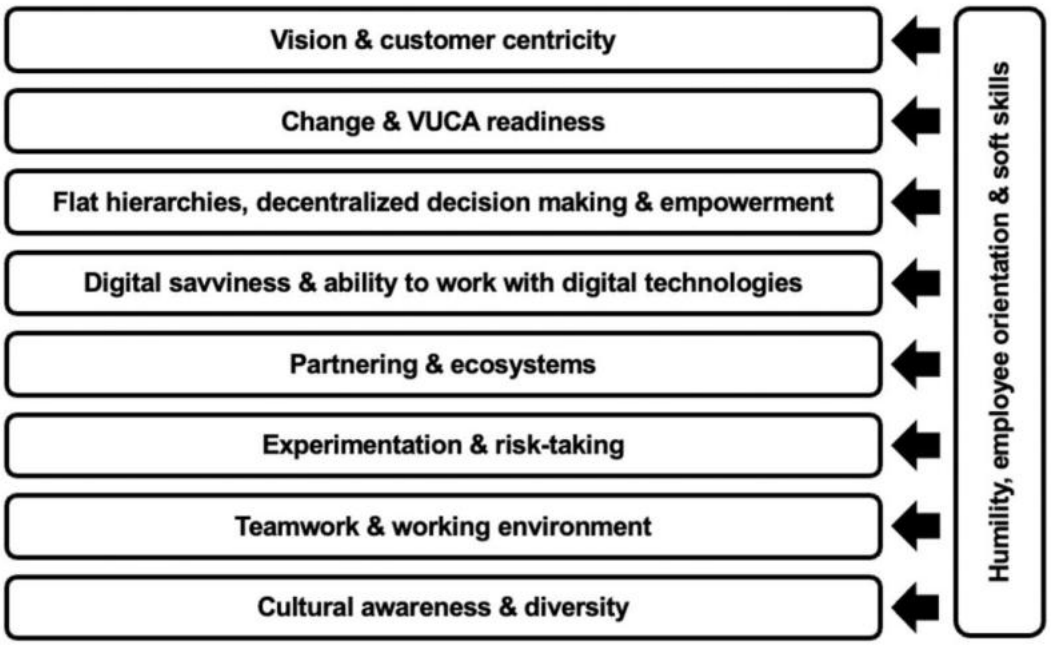

Figure 2: Results Paper #1 - Nine themes for leadership of internal and external digitalization (Tagscherer & Carbon, 2023)

The first theme centers around creating a vision that gives direction for transforming companies with the help of digital technologies (Kazim, 2019; Tagscherer & Carbon, 2023; Westerman et al., 2014). Furthermore, communicating and translating the vision toward the employees is a leadership characteristic for digitalization (Guzmán et al., 2020; Ivančić et al., 2019; Tagscherer & Carbon, 2023). Being creative and visionary (Imran et al., 2020; Larjovuori et al., 2018) with a strong focus on innovation are central attributes for leaders to attain customer-centricity within digital transformation (Imran et al., 2021; Tagscherer & Carbon, 2023). Understanding customers' needs is essential for the external leadership dimension to tailor products, services, and business models according to market needs (Li et al., 2016; Tagscherer & Carbon, 2023).

The second theme highlights the leaders' ability to moderate the VUCA (Volatile, Uncertain, Complex, and Ambiguous) business environment in the context of digitalization (de Araujo et al., 2021) and embrace change (Sainger, 2018) by being adaptable and open-minded (Guzmán et al., 2020; Imran et al., 2021). Additionally, fast decision-making (Larjovuori et al., 2018) and agility (Kohli & Johnson, 2011) support leading internal IT departments and quickly adapting to changes in the external market and technology surroundings. In line with fast decisions, the extant

literature on digital leadership recommends flat hierarchies (Foerster-Metz et al., 2018), empowering employees (Eberl & Drews, 2021), and delegating the decision-making responsibility (El Sawy et al., 2016). In conclusion, employees should be granted more autonomy within given boundaries (Danoesastro et al., 2020; Kane et al., 2018; Tagscherer & Carbon, 2023). Although leading digitalization does not require a detailed technical understanding, the findings identified the necessity of a basic knowledge of digital technologies, also called digital savviness or digital literacy, as an important leadership competence to build successful digital business models (Eberl & Drews, 2021; Tagscherer & Carbon, 2023). Also, understanding the impact of social media and data-driven marketing (Darics, 2020) supports the leadership of external digitalization projects (Tagscherer & Carbon, 2023).

The collaboration with the "outside world" during partnering and participating in ecosystems supports the internal and external perspective of digitalization by increasing the organization's ability to innovate and grow (Gurumurthy & Schatsky, 2019; Tagscherer & Carbon, 2023). On the internal side, an open model to work with freelancers and contractors adds speed and flexibility to the IT department (Foerster-Metz et al., 2018; Li et al., 2016). The joint creation of product and business models with customers and other ecosystem partners is a critical success factor for the external dimension of digital leadership (Larjovuori et al., 2018). Leaders must provide safe environments within the companies (Philip & Gavrilova Aguilar, 2021) that allow for experimentation (El Sawy et al., 2016; Kane et al., 2018) and risk-taking to establish a failure culture (Kane et al., 2017). The context of fast-failing (Kazim, 2019) and learning from mistakes (Bennis, 2013) was especially outlined as critical digital leadership capacity. A collaborative work environment that promotes teamwork and cross-functional collaboration needs to be actively pursued by leaders in digitalization (Imran et al., 2021; Kazim, 2019; Philip, 2021; Tagscherer & Carbon, 2023). Furthermore, attracting and retaining talent (Chuang & Graham, 2020; Vrana & Singh, 2021) helps to build high-performance teams, which extant literature describes as supportive of pursuing digital activities (Jakubik & Berazhny, 2017). As digitalization promotes virtual teams and global collaboration, intercultural competencies (Eberl & Drews, 2021; Rüth & Netzer, 2020) and supporting multigenerational workforces (Cresnar & Nedelko, 2020; Herold, 2016) need to be considered when leading companies' digital transformation. The final theme, "humility, employee orientation &

soft skills," complements the findings as overarching leadership skills that influence the other identified areas. Jesse (2019) described people-oriented leadership and putting people at the center as critical success factors for leading in a digital environment. Building trust (Schwarzmüller et al., 2018) and open and transparent communication (Foerster-Metz et al., 2018; Vrana & Singh, 2021) internally and externally toward customers create a supportive work environment (Tagscherer & Carbon, 2023). Additional soft skills include being visionary (Larjovuori et al., 2018), authentic (Hesse, 2018), and being resilient (Bennis, 2013; Singh & Hess, 2017).

In summary, the literature review's results provide an overview of the required leadership skills for digitalization. Furthermore, our findings outline specific aspects that find distinct applications for either internal or external digitalization activities. The outlined leadership themes are intertwined and support each other (Tagscherer & Carbon, 2023). Lastly, the finding that the literature review did not identify any literature connecting the search terms digital servitization and leadership offered an additional research gap, which was tackled in the proceeding research (Tagscherer & Carbon, 2023, 2024).

5.2 Results Paper #2

The results of the second research on a holistic view of leadership traits and skills for digital servitization were derived from semi-structured interviews and presented in a three-stage model (Tagscherer & Carbon, 2024). Furthermore, the outlined leadership skills were mapped based on a model created by Mumford et al. (2007), that classifies leadership skills into cognitive, interpersonal, business, and strategic categories. Following Braun and Clarke's (2006) thematic analysis, I analyzed the interview data inductively. I derived 19 sub-themes categorized into five themes and two overall perspectives, as presented in Figure 3.

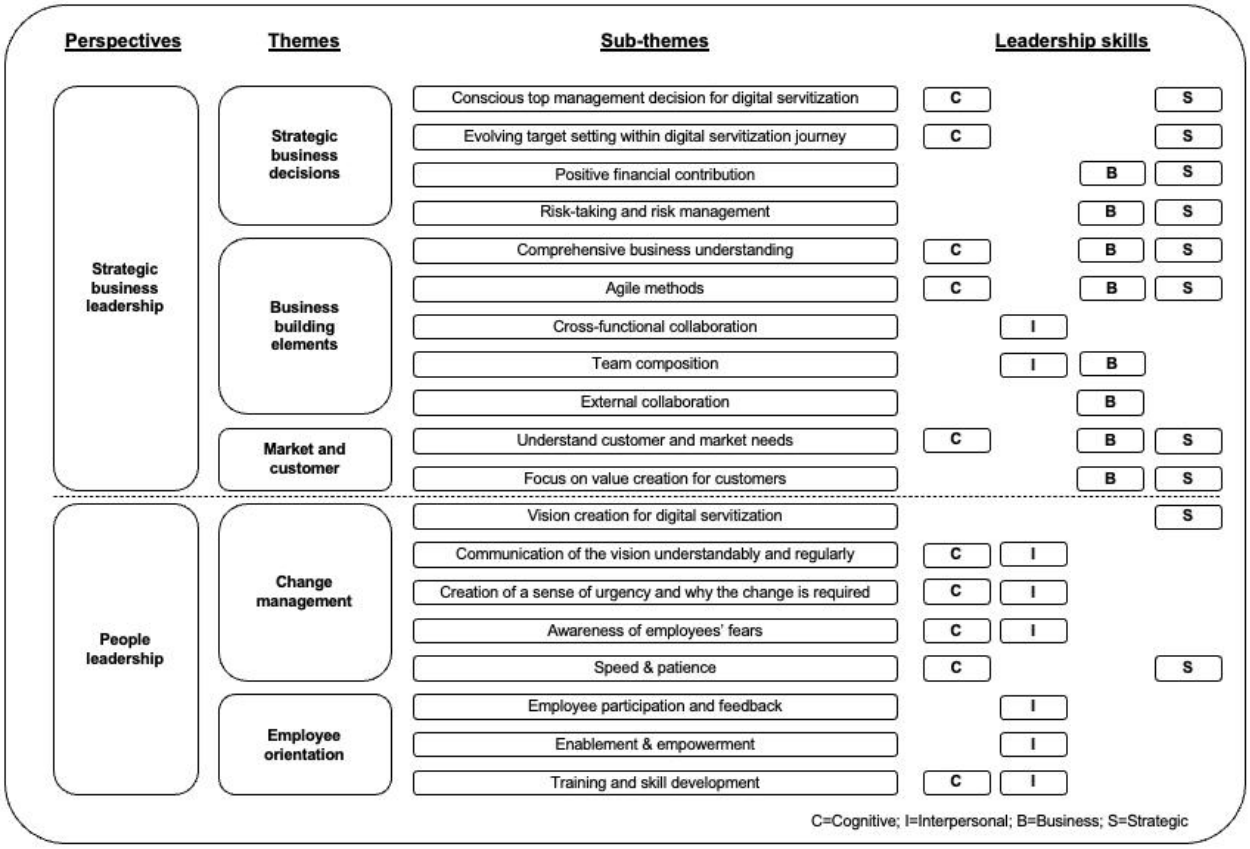

Figure 3: Results Paper #2 - Holistic leadership skills for digital servitization (Tagscherer & Carbon, 2024)

The presented structure underlines the need for a holistic leadership approach for digital servitization. On the one hand, the leadership skills summarized within the perspective of "strategic business leadership" represent focus areas associated with a business focus. Based on the research findings, leaders must make strategic business decisions and possess a strategic mindset to set their organization's guardrails for digital servitization activities. Firstly, it requires a conscious top management decision whether to pursue digital servitization and consequently set up the appropriate structures and team assignments (Tagscherer & Carbon, 2024). The measurements to assess the business success of digital servitization should have two specific attributes. They should not solely be linked to financial attributes but also include qualitative and customer-oriented targets. Secondly, leaders should apply an evolving and short-cycled goal-setting approach based on the companies' digital servitization maturity levels (Tagscherer & Carbon, 2024). The research participants explicitly highlighted the need for leaders to focus on the target to provide a positive financial contribution of digital servitization activities in the mid to long term by creating

self-sustaining business models (Tagscherer & Carbon, 2024). Taking calculated risks and managing the risks associated with digital servitization concludes the findings on strategic business decisions.

The second theme, “business building elements,” summarizes elements of organizational setups and inter- and intraorganizational collaborations as leadership focus areas to build digital servitization business models. A central finding is labeled as “comprehensive business understanding.” It describes that leaders need a holistic and balanced understanding of technology, business processes, sales approaches, and associated financials and monetization models for offering and executing digital services (Tagscherer & Carbon, 2024). The use of agile methods such as SCRUM to allow fast developments and quick adoptions to changing technology or market environments is another research finding (Tagscherer & Carbon, 2024). In line with the comprehensive business understanding and underlining the holistic leadership approach, building and supporting cross-functional team collaboration is key for leaders within digital servitization (Tagscherer & Carbon, 2024). The interviewed digital servitization leaders emphasized the need to combine specialized domain expertise from various departments such as IT, services, engineering, sales, marketing, or finance as a critical success factor. Therefore, composing teams is an essential leadership skill that supports cross-functional teams. This sub-theme includes selecting the right employees and finding a proper balance between the team members’ experience, innovativeness, and diverse ways of thinking (Tagscherer & Carbon, 2024). Besides collaborating internally, the research participants highlighted the importance of external collaboration with development partners to gain technology access and execution speed (Tagscherer & Carbon, 2024).

The third theme, “market and customer,” within the strategic business leadership perspective, focuses on the leaders’ ability to understand customer problems and tailor digital servitization offerings based on customer needs (Tagscherer & Carbon, 2024). Accordingly, leaders need to ensure that digital servitization business models provide additional value for customers and that the associated communication is centered on the benefits of the offerings (Tagscherer & Carbon, 2024).

Besides a strong focus on strategic business aspects, the research participants emphasized that the people perspective is important for a holistic and successful

approach to leading digital servitization. Two main themes were derived from the analysis in this area: “change management” and “employee orientation.” One of the research participants described the convergence of digitalization and servitization as a massive change within companies (Tagscherer & Carbon, 2024). Thus, change management is a central research finding and entails four sub-themes. The first leadership skill relates to creating a vision for digital servitization that explains the direction a company wants to go with digital servitization to its employees. It is a critical success factor to paint a desired future state that motivates employees to contribute to digital servitization activities (Tagscherer & Carbon, 2024). Regularly communicating the vision and its translation to make it understandable for employees is another leadership skill to master in digital servitization within the change management category (Tagscherer & Carbon, 2024). In line with communication, explaining the “why” and creating a sense of urgency are additional focus areas within the change management elements. It supports initiating the change process by making the employees understand the necessity better (Tagscherer & Carbon, 2024). The consideration and awareness of employees’ fear as part of the change procedure toward digital servitization plays a significant role in the people leadership perspective. Due to changing job requirements and new technologies, leaders must consider uncertainty and react accordingly to overcome potential resistance in the transformation process (Tagscherer & Carbon, 2024). The final aspect of change management relates to finding the right balance between pushing for implementation speed of digital servitization activities and acknowledging that the overall change process takes time (Tagscherer & Carbon, 2024).

The final theme, “employee orientation,” summarizes the leaders’ required soft skills for digital servitization (Tagscherer & Carbon, 2024). The research participants often mentioned the following attributes: empowering and actively seeking employees’ feedback (Tagscherer & Carbon, 2024). Training and skill development complete the findings as the novel context of digitalization and servitization requires specific education and the provision of learning opportunities (Tagscherer & Carbon, 2024). Additionally, the outlined soft skills are overarching leadership characteristics supporting other themes like employee involvement and allowing for freedom within given boundary conditions. These leadership traits interact with other strategic

business leadership skills and support their implementation, such as vision creation or goal setting.

The mapping of the 19 sub-themes to the leadership skills outlined by Mumford et al. (2007), who categorize them into cognitive, interpersonal, business, and strategic leadership skills, showed a balanced picture (see Figure 3). This underlined the importance of applying a holistic leadership approach for digital servitization due to the diverse requirements (Tagscherer & Carbon, 2024). Whereas the upper sub-themes, representing the strategic business leadership perspective, include more business and strategic leadership skill requirements, cognitive and interpersonal leadership skills are more associated with the people leadership perspective, which confirms the categorization and labeling of the identified themes (Tagscherer & Carbon, 2024). The demonstrated balance underlines the importance for leaders to focus on both perspectives and not to neglect one of the two areas of strategic business and people leadership.

5.3 Results Paper #3

The findings of identified leadership skills for digital servitization from Paper #2 originated from a general research question to generate exploratory insights into the research topic. For Paper #3, I narrowed the focus and investigated the fit of a specific leadership style, transformational leadership, to digital servitization. Based on a hybrid of deductive and inductive analysis approaches, the findings for transformational leadership characteristics, including the coding amount, are presented in Figure 4. The structure for the deductive analysis originated from a literature review on transformational leadership, where exemplary characteristics for the four dimensions (The dimensions of the four Is are: Idealized influence, inspirational motivation, individual consideration, and intellectual stimulation) of transformational leadership were identified (see Table 1 in Paper #3). Furthermore, I added codes by inductively analyzing the transcripts. The origin of the codes is depicted after each code. The greyscale reflects the coding amount during the analysis. I structured the codes into themes and dimensions through thematic analysis (Braun & Clarke, 2006).

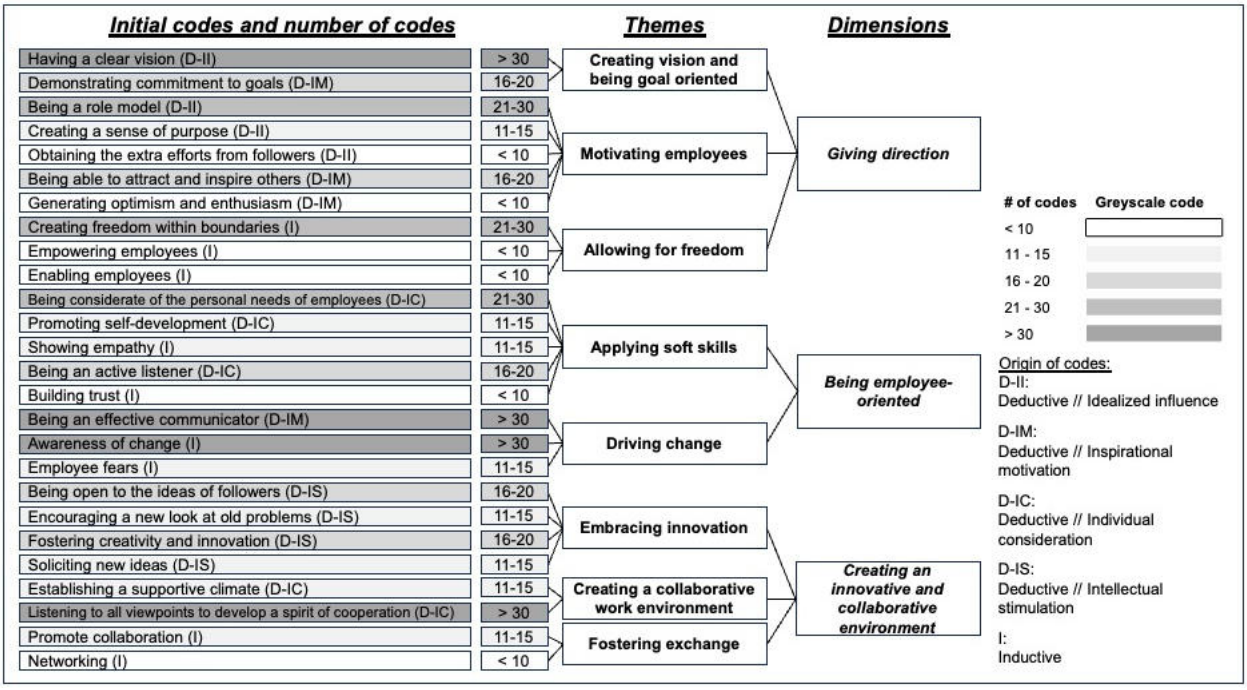

Figure 4: Paper #3 - Results of deductive and inductive analysis - transformational leadership for digital servitization (Tagscherer & Carbon, 2025)

The thematic map's first dimension represents the leadership skill of giving direction. This includes having a clear vision and goal orientation (Tagscherer & Carbon, 2025). Motivating employees to participate in digital servitization activities is another transformational leadership characteristic the research participants emphasized during the interviews. Especially the aspects of being a role model and attracting and inspiring others received a high number of codes during the analysis (Tagscherer & Carbon, 2025). The theme "allowing for freedom" was derived inductively and complements "giving direction" through a clear vision. Employees should be empowered and enabled by being given freedom within defined boundaries, which could be established by a vision (Tagscherer & Carbon, 2025).

The second dimension exemplifies the transformational leadership characteristics centered around employee orientation. I categorized the two themes "applying soft skills" and "driving change" as leadership focus areas for digital servitization. The items "being considerate of the personal needs of employees" and "being an active listener" were especially highlighted by the research participants (Tagscherer & Carbon, 2025). Outlining these specific soft skills adds more details to the scientific discussion for required leadership soft skills for digital servitization (Cimini et al., 2021). In confirmation with existing research findings, change management is a

central element for leaders to succeed in digital servitization (Bustinza et al., 2018). Leaders should actively drive the necessary change, supported by being effective communicators (Tagscherer & Carbon, 2025). A critical pre-requisite for leaders is the awareness of the required change itself and being cognizant of employees' fears arising from changes in the work environment and job requirements (Tagscherer & Carbon, 2025).

The third dimension, "creating an innovative and collaborative environment," primarily originates from the transformational leadership dimension of intellectual stimulation (Tagscherer & Carbon, 2025). The three themes "embracing innovation," "creating a collaborative work environment," and "fostering exchange" underline that digital servitization requires leaders to create an atmosphere that allows employees to be innovative and creative. However, except the code "listening to all viewpoints to develop a spirit of cooperation," all other items only received coding counts in the lower to medium range, underlining its importance but based on the research participants' feedback, not the utmost leadership priority for digital servitization (Tagscherer & Carbon, 2025). Nevertheless, leaders should promote collaboration within and across departments and with other companies by fostering cross-functional exchange and networking (Tagscherer & Carbon, 2025).

As a section of the semi-structured interviews investigated use cases for transactional leadership, the opposite leadership style to transformational leadership, for digital servitization, I analyzed the respective responses inductively. Based on the results, three context-specific application areas were derived for transactional leadership in digital servitization (see Table 4 in Paper #3) (Tagscherer & Carbon, 2025). Firstly, the digital servitization experts saw a use case for transactional leadership from a time context associated with different evolutionary stages of digital servitization - most codes related to "implementation & improving" as applicable use cases for transactional leadership. The interviewed leaders saw a benefit from gradually shifting from transformational leadership to transactional leadership once digital servitization models have been implemented and are maturing to facilitate further scaling (Tagscherer & Carbon, 2025). The second use case is associated with an application context, specifically "crisis mode." The interview participants saw relevance in applying more transactional leadership elements to manage potentially upcoming crises, such as failing data connections or issues with customer

relationships (Tagscherer & Carbon, 2025). The third use case of transactional leadership for digital servitization relates to a people context. One example mentions cultural or geographical differences that prefer transactional leadership approaches. Another example refers to different departments within a company, where the research participants emphasized that leading sales and service employees could be more of a transactional-oriented leader in the context of digital servitization activities based on their job profiles (Tagscherer & Carbon, 2025). Figure 5 summarizes the identified focus areas and associated activities for transformational leadership for digital servitization and the outlined use cases for transactional leadership and their respective context. The activities correspond to the initial codes but have been summarized based on high coding numbers and rephrased for better conciseness and readability.

Figure 5: Results Paper #3 - Focus areas for leadership for digital servitization (Tagscherer & Carbon, 2025)

5.4 Synthesis of the research findings

Although all three research papers investigated specific and unique research gaps, the overarching research topic centers around the required leadership skills for digitalization within companies. Based on the chosen approach of cumulative research, the research evolved from the more general subject of leadership for internal and external digitalization, which was explored through a literature review, to a more distinct and narrow avenue with leading digital servitization as a sub-topic of digitalization. For the third paper, the understanding of leading digital servitization was

further detailed by researching the specific transformational leadership style. Consequently, I outline the overarching research findings identified across all three research papers and emphasize their importance in my overarching research subject of the leadership of digitalization and digital servitization activities.

Holistic leadership approach

Originating from the first paper's research question, where potential similarities and differences in leadership for internal and external digitalization activities were investigated, I consistently identified a need for a holistic leadership approach for digitalization and digital servitization. The holism can be explained from different perspectives. Firstly, leaders must interact with the internal and external company perspective when leading companies' digital initiatives. Internally, they need to establish organizational structures and foster team interaction (Tagscherer & Carbon, 2023, 2024, 2025). The goal-setting process appropriate to the associated business model and digital maturity stage is also an internally oriented leadership task (Tagscherer & Carbon, 2023, 2024). From an external perspective, my research findings outline the need for leadership abilities to be customer-oriented and have a good market understanding (Tagscherer & Carbon, 2023, 2024). Furthermore, exchanging and collaborating with external partners is a critical success factor for leading digitalization and digital servitization (Tagscherer & Carbon, 2023, 2024, 2025).

Another perspective that underlines the need for a holistic leadership approach is balancing strategic decision-making and people leadership, which explicitly was outlined in Paper #2 as separate leadership perspectives (Tagscherer & Carbon, 2024). However, despite not being specifically called out in the other two papers, I see this pattern applied consistently. In Paper #1, whereas topics such as vision creation, risk-taking, partnering, and ecosystems can be associated with strategic leadership thinking, the dimensions of empowerment, teamwork, or humility can be attributed to people leadership (Tagscherer & Carbon, 2023). A similar distinction can also be seen within the transformational leadership characteristics for digital servitization in Paper #3, which also includes aspects of strategic and people leadership perspectives (Tagscherer & Carbon, 2025).

A further aspect confirming the argument of holistic leadership for digitalization and digital servitization is reflected in the multi-faceted involvement of different functions, departments, and, therefore, the leader's ability to understand their backgrounds and skill sets. For example, Paper #1 emphasized digital savviness and the ability to work with and understand digital technologies (Tagscherer & Carbon, 2023). Paper #2 outlined the need for a comprehensive business understanding, described as having a balanced sense of different contributing factors in digital servitization (Tagscherer & Carbon, 2024). This, for example, includes the sales, technology, or finance aspects that interact when building and scaling digital servitization business models. Besides having a basic understanding of those different functional areas within the company, I specifically identified across all three papers that cross-functional collaboration is a key success factor for leading digitalization within companies (Tagscherer & Carbon, 2023, 2024, 2025).

As explicit confirmation for the holistic leadership requirement, I emphasized a balanced distribution of cognitive, interpersonal, business, and strategic leadership skills according to Mumford et al. (2007) for digital servitization as presented in Figure 3 (Tagscherer & Carbon, 2024). Based on my conclusions above, expanding this structure to the other two research findings provides orientation for leaders for digitalization activities.

Visionary mindset

The second recognizable leadership attribute is being visionary and creating compelling visions to give employees direction for digitalization and digital servitization. Across all three papers, existing literature and the research participants highlighted the ability to create a vision as one of the most important leadership skills (Tagscherer & Carbon, 2023, 2024, 2025). In Paper #3, it was recognized as a code with significant mentions, which underlines its importance (see Figure 4) (Tagscherer & Carbon, 2025). The vision provides guidance and paints a picture of the future that employees can use as orientation. Furthermore, it gives guard rails to allow employees freedom, a pre-requisite for empowering employees to reach the aspired target state. Freedom within boundaries was explicitly outlined in Paper #3 as a crucial transformational leadership characteristic for digital servitization (Tagscherer & Carbon, 2025). The visionary mindset includes the ability to properly communicate and

translate the vision to the employees, which was also a consistent finding in the three research papers. The visionary mindset is associated with innovation, specifically with the leadership characteristics of experimentation and increased risk-taking (Tagscherer & Carbon, 2023). However, the findings of the second paper on holistic leadership skills for digital servitization express the need to manage and mitigate risks (Tagscherer & Carbon, 2024).

Change management

Change management was a central leadership focus area throughout the research papers. The review of existing literature for leadership skills in general digitalization often linked the need for change with adaptability and in context with the VUCA environment. Mainly due to fast-paced changes in technology and competitive environment, changes were highlighted in previous research and consequently outlined in Paper #1's literature review (Tagscherer & Carbon, 2023). In the context of leading digital servitization (Paper #2 and #3), the focus was more oriented towards the employees. A change in job responsibilities or work environment needs to be accompanied by leaders to mitigate employees' fears of upcoming changes (Tagscherer & Carbon, 2024, 2025). Primarily, the convergence of two disrupting factors – digitalization and servitization – explains the high importance of change management for digital servitization. Based on Hay's (2006) research that transformational leadership is suitable for managing change, these tendencies were confirmed in the third research paper by outlining the fit of transformational leadership for digital servitization and highlighting change management as an essential leadership skill (Tagscherer & Carbon, 2025).

Employee orientation

The final overarching finding is that leaders should be employee-oriented for digitalization and digital servitization. Despite investigating different research questions, applying various research methods, and using different analysis procedures, all three papers resulted in labeling one theme, employee orientation, underlining its overarching significance. For Paper #1, the employee orientation theme was paired with the leadership attributes of humility and soft skills, complementing leadership performance through improving personal relationships (Tagscherer &

Carbon, 2023). In Paper #2, employee orientation was one of the two themes from the people leadership perspective. It included the leadership aspects of letting employees participate in decisions and goal-setting procedures (Tagscherer & Carbon, 2024). Furthermore, enablement and empowerment have been outlined and summarized within employee orientation. Empowering employees is a leadership theme frequently emphasized in the research papers. The first level dimension of being employee-oriented from Paper #3 mainly originates from the transformational leadership characteristic of individual consideration. Within this context, change management was mainly associated with the need to address employees' fears and related communication skills (Tagscherer & Carbon, 2025). The second theme of the employee orientation dimension in Paper #3 summarized the need to apply soft skills for leaders to succeed in digital servitization. Soft skills were also a significant result of Paper #1's literature review that was collated with employee orientation (see Figure 2) (Tagscherer & Carbon, 2023, 2025). Therefore, I conclude that soft skills and their proper application are overarching leadership skills for digitalization and digital servitization. They positively contribute to achieving other leadership aspects by, for example, being resilient, humble, or authentic, as presented in Paper #1 (Tagscherer & Carbon, 2024).

The following Figure 6 summarizes my overarching research findings and outlines the leadership skills in the four items: Holistic leadership approach, visionary mindset, change management, and employee orientation. The clustered presentation emphasizes the background and origin of each research paper and supports the nuanced view based on the research questions and approaches.

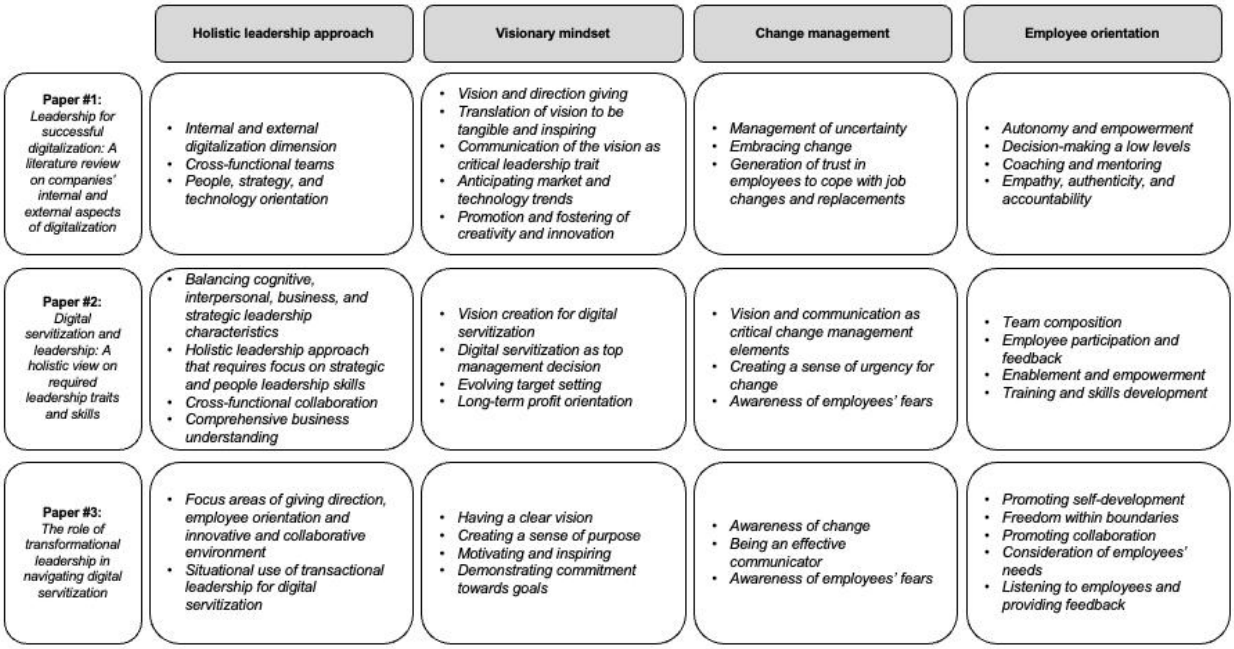

Figure 6: Synthesis of overarching research results

6 Discussion

My research on leading companies' digitalization activities tackles an important aspect for scientific discussion and practitioners across several industries. Digitalization offers significant innovation potential (Radicic & Petković, 2023) and possibilities to improve companies' financial performances (Yang et al., 2024). Despite noticeable investments, incumbent companies struggle to seize the opportunities presented by digitalization (Kallmuenzer et al., 2024) and digital servitization (Kolagar et al., 2022; Tronvoll et al., 2020). The scientific community has acknowledged the need for appropriate leadership for digitalization activities through an increasing amount of publications and establishing the research subject of digital leadership based on which findings Paper #1's literature review was created. However, the results revealed that digital leadership research provides rather general leadership recommendations focusing on company-overarching digital transformation activities. My research confirmed these tendencies by categorizing the identified articles for the literature review in Table 1, where the majority were classified as organization-focused and lower counts for the internal or external digitalization perspective (Tagscherer & Carbon, 2023).

Although the literature review's outlined leadership skills for digitalization activities can be generally perceived as valid, the empirical research work through semi-structured interviews for Papers #2 and #3 on leading digital servitization, as specific digitalization activity, discovered that use-case-specific adaptations are required. For example, whereas general digital leadership literature recommends acting boldly and taking risks for digitalization (Breuer & Szillat, 2019; Kwiotkowska et al., 2021; Michna & Kmieciak, 2020), our findings still suggest risk-taking for digital servitization, but those should always be managed and mitigated within the process to limit companies' overall risk exposure (Tagscherer & Carbon, 2024). Based on the research findings, an additional example of an adaptation represents the understanding of change and the leadership skill of change management between leading digitalization and digital servitization. Based on the literature review on leadership skills for internal and external digitalization, the topic of change was often associated with VUCA and a fast-paced environment (Tagscherer & Carbon, 2023). Introducing new digital technologies requires quickly responding and flexibly adapting to changes in technology and market environments (de Araujo et al., 2021; Kazim, 2019). The focus is on the pace of required changes and the abilities of leaders to drive and implement agile changes within the company (Sainger, 2018; Zulu & Khosrowshahi, 2021). Although using agile methods and a balance of speed and patience was still acknowledged by the research participants for the leadership of digital servitization (Tagscherer & Carbon, 2024), I saw a much stronger focus on employees as individuals, their feelings, opinions, and roles within the change process towards digital servitization (Tagscherer & Carbon, 2024, 2025).

In general, the research on leadership for digital servitization strongly emphasized people leadership and employee orientation (Tagscherer & Carbon, 2024, 2025). Although strategic leadership aspects such as goal-setting, organizational structures, or digital savviness are present within all three research papers, my findings offer more detailed insights that emphasize the required soft skills and leaders' characteristics that allow successful change management and employee empowerment for digital servitization. These results advance Cimini et al.'s (2021) research by providing additional insights on competencies and soft skills for digital servitization.

Providing a holistic view of required leadership skills from different perspectives offers valuable insights for the research community and practitioners for digitalization and digital servitization. Firstly, recognizing differences between internal and external digitalization and associated leadership skills offers a novel perspective on digital leadership research. The activities can be viewed as different learning and innovation activities in the context of explorative or exploitative digitalization efforts (Jafari-Sadeghi et al., 2021). Based on research by Hoessler and Carbon (2024), leaders should treat digital exploration and exploitation activities differently, which I see as further research opportunities to link internal and external digitalization to exploration and exploitation activities.

The distinct focus on a holistic and well-rounded view on leadership for digitalization and digital servitization is a significant contribution resulting from the present research compared to the existing body of research, especially in the context of digital servitization literature. Missing this broad view in existing literature presents an explanation of why companies were falling behind their expectations in managing digital servitization's inherent complexity (Pham & Vu, 2022). Several leadership skills for digital servitization have been identified or can be transferred from general digital leadership skills. Creating a vision is an important core element of existing research on leading digitalization (Imran et al., 2020; Kazim, 2019; Kwiotkowska et al., 2021; Westerman et al., 2014) and digital servitization (Chirumalla et al., 2023; Favoretto et al., 2022; Pham & Vu, 2022; Sklyar et al., 2019; Tronvoll et al., 2020). Also, the requirement of leading change is acknowledged in existing research on leadership literature for digitalization (Kane et al., 2019; Neubauer et al., 2017; Sainger, 2018; Schmidt, 2019) and digital servitization (Bustinza et al., 2018; Coreynen et al., 2020; Favoretto et al., 2022; Tronvoll et al., 2020). However, combining the different perspectives relevant to successfully leading digitalization and digital servitization, including cognitive, interpersonal, business, and strategic leadership skills, provides a novel and holistic view that provides an orientation for future research projects and practitioners because so far only isolated or specifically focused recommendations were outlined for leading digital servitization (Tagscherer & Carbon, 2024).

The particular research approach to investigate the fit of transformational leadership offered an additional and more specific viewpoint on how to lead digital servitization. Based on previous scientific findings, the transformational leadership

style supported digital leadership (Alos-Simo et al., 2017; Philip, 2021) and servitization (Kim & Toya, 2018). Research Paper #3 underlined the fit of transformational leadership to digital servitization and presented situational use cases for transactional leadership (Tagscherer & Carbon, 2025). Furthermore, the research results outlined distinct leadership skills within transformational leadership, specifying the leaders' focus areas in more detail than previous research.

7 Limitations and implications for future research

Despite using scientific rigor within the research process, I still want to acknowledge the limitations of the research, outline already incorporated mitigative actions, and propose implications for future research. A literature review was conducted for the first research to analyze and synthesize existing research on digitalization and leadership. Although valuable research findings such as the presented nine leadership themes (see Figure 2) were derived and a research gap on digital servitization and leadership was identified, the research method of literature reviews is limited to its inherent approach to reproducing existing knowledge (Snyder, 2019). Nevertheless, analyzing and presenting leadership skills for digitalization through the viewpoint of internal and external leadership provided novel insights based on how the large body of existing research was synthesized. Furthermore, this concern was addressed by using empirical research through semi-structured interviews for the research on digital servitization and leadership within the second and third research paper.

The amount of thirty research participants for the qualitative research represents a relatively high number of interview partners, which was derived through code saturation during the interview and coding stage (Weller et al., 2018). However, due to the exploratory nature of empirical research, the thirty research participants were associated with different categories such as industry, hierarchical rank, or leadership experience (see Table 2 in Paper #2), showing a balanced distribution within the categories. Although it supported the chosen research design of exploratory insights into the underresearched area of digital servitization and leadership, based on a diverse and balanced set of interviewed experts, it consequently limits the statistical validity of insights to, for example, specific industry sectors. Therefore, I recommend further empirical research on digital servitization and leadership to investigate specific focus areas or differences within or between industry sectors. This

specialization allows more specific insights into affected industries, such as machinery, automobiles and components, or electrical equipment.

Another limitation of the chosen research approach, especially in Papers #1 and #2, is that the resulting themes are not ranked or prioritized. As the findings did not outline the number of counts during the inductive analysis and coding procedure, the results presentations (see Figures 2 and 3) did not indicate which leadership skills are potentially more important than others. From the perspective of practicability for leaders, it hinders a sequential approach by prioritizing certain aspects based on their impact on successful leadership. This downside was mitigated within the third research paper by displaying the number of codes for transformational and transactional leadership skills (see Figure 4 and Table 4 in Paper #3), which were the baseline for the summary of required leadership skills for digital servitization (see Figure 5). This approach was possible due to deductively analyzing the research data, as the previously outlined transformational leadership characteristics (see Table 1 in Paper #3) were used as a template for the coding process instead of the purely inductive coding process of Papers #1 and #2. Thus, I propose further research that details the identified leadership themes for digitalization and digital servitization to derive a prioritization or ranking. Future research could use the thematic maps and apply more quantitatively oriented research to statistically validate, adapt, or prioritize the findings.

As mentioned, I recommend future research on industry-specific leadership for digital servitization. In a similar context, I see significant value in research focusing on regional or cultural differences for leading digital servitization. My recommendation arises from research participants' statements from Paper #3 that proposed differences in the effectiveness of transformational or transactional leadership styles across cultures or geographical regions (Tagscherer & Carbon, 2025). These tendencies were also supported by Budur (2020), who confirmed that transformational leadership is more effective in low-avoidance cultures, and transactional leadership is more suited in regions with high-power cultures. Therefore, future and more in-depth research supports fostering the research findings on leading digitalization and digital servitization. Furthermore, it offers the potential to identify specialties where a general application of the research findings is misleading and results in inferior success for leadership based on incorrect assumptions or pre-conditions. However, as the

research participants did not directly present ineffective use cases and confirmed the overall findings, I still underline the correctness of the findings but emphasize the potentially required awareness between cultures and regions.

8 Conclusion

The present research on leadership for digitalization has an evolving character. The first of the three research papers investigated the required leadership skills and traits for digitalization, specifically emphasizing internal and external digitalization activities. Based on a literature review, the analysis identified nine themes for digital leadership. Additionally, a research gap was identified on how to lead digital servitization as a sub-topic of digitalization that was focused on in the second and third research papers. The research partners chose semi-structured interviews as the qualitative research method to obtain exploratory insights. The inductive analysis revealed holistic leadership to be essential for digital servitization. A balance between strategic and personal leadership, which considers cognitive, interpersonal, business, and strategic leadership skills, was derived based on the interviews with thirty digital servitization leaders. For the third research paper, the fit of transformational leadership for digital servitization was investigated. As a result of inductive and deductive analysis, transformational leadership was confirmed as suited for digital servitization, and specific use cases for transactional leadership, as opposing leadership style were outlined. The findings particularly presented distinct transformational leadership characteristics that support leaders in advancing digital servitization in companies.

Throughout the three research papers that followed similar but distinct research targets, I investigated leadership skills for digitalization and digital servitization. I identified focus areas that were consistently identified through all papers. The creation and communication of a vision, a focus on change management, and employee orientation are the main leadership tasks for all digitalization activities. Considering a holistic perspective that balances internal and external activities and strategic and people leadership orientation is important for the complex undertaking of the leadership of digitalization and digital servitization initiatives.

My research offers a structured approach to leadership for digitalization and digital servitization. It underlines the need for holistic leadership to unfold the complex digitalization activities, which can be expanded in future research. For practitioners,

the thematic maps provide guidelines on approaching initiatives or identifying root causes for struggling projects and business models.

CRediT author statement

The present dissertation summarizes and synthesizes three peer-reviewed and open-access published research papers on leadership for digitalization and digital servitization. Florian Tagscherer and Claus-Christian Carbon have conducted the cumulative research project. The specific contributions are outlined below following the CRediT methodology.

Paper #1:

Tagscherer, F., & Carbon, C.-C. (2023). Leadership for successful digitalization: A literature review on companies' internal and external aspects of digitalization. Sustainable Technology and Entrepreneurship, 2(2), 100039. https://doi.org/10.1016/j.stae.2023.100039

Tagscherer, Florian: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – Original draft, Writing – Review & Editing, Visualization, Project administration. **Carbon, Claus-Christian:** Conceptualization, Methodology, Validation, Writing – Review & Editing, Supervision, Project administration

Paper #2:

Tagscherer, F., & Carbon, C.-C. (2024). Digital servitization and leadership: A holistic view on required leadership traits and skills. Journal of Entrepreneurship, Management and Innovation, 20(4), 104–129. https://doi.org/10.7341/20242046

Tagscherer, Florian: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – Original draft, Writing – Review & Editing, Visualization, Project administration. **Carbon, Claus-Christian:** Conceptualization, Methodology, Validation, Writing – Review & Editing, Supervision, Project administration

Paper #3:

Tagscherer, F., & Carbon, C.-C. (2025). The role of transformational leadership in navigating digital servitization. Sustainable Technology and Entrepreneurship, 4(2), 100098. https://doi.org/10.1016/j.stae.2025.100098

Tagscherer, Florian: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – Original draft, Writing – Review & Editing, Visualization, Project administration. **Carbon, Claus-Christian:** Conceptualization, Methodology, Validation, Writing – Review & Editing, Supervision, Project administration

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Appendix

Paper #1

Sustainable Technology and Entrepreneurship 2 (2023) 100039

Sustainable Technology and Entrepreneurship

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Review

Leadership for successful digitalization: A literature review on companies' internal and external aspects of digitalization

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ABSTRACT

Digitalization is a global megatrend that changes companies' internal and external value-creation activities. The introduction of digital technologies requires organizations to adapt their internal operations and external product and service offerings to remain competitive. Leaders must possess specific skills and characteristics to guide their organization successfully through digitalization. We conducted a literature review to research which leadership skills are required for successful digitalization regarding companies' internal and external dimensions. We employed an inductive analysis that identified 92 articles from 2011 to 2021, which allowed us to structure the results into nine main themes. We revealed that leaders for successful digitalization must be visionary and customer-centered while embracing change. Supporting properties for successful leadership in digitalization are flat hierarchies, empowering employees, possessing digital savviness, and engaging in partnerships and ecosystems. In conclusion, digitalization requires true leadership, not mere management, to embrace risk-taking and promote teamwork and collaboration. This includes continuous awareness of diversity and cultural differences, which must be actively managed.

Introduction

Digital disruption changes how people live, socialize and work (Nyagadza, 2022). Digitalization of products and services is a fast-moving, global megatrend that fundamentally changes existing value chains (Collin, 2015). Companies in almost all industries have conducted several initiatives to explore new digital technologies and exploit their benefits (Matt et al., 2015). Digital technologies often affect large parts of companies as they are embedded in the core of the products, services, and operations (Yoo et al., 2012). The potential benefits of digitalization, from its value creation to businesses, are manifold. Two complementary dimensions are outlined to succeed in digital transformation. On the one hand, digital technologies transform internal operations and innovate manufacturing processes and internal value chains (Matt et al., 2015; Vogelsang et al., 2018). On the other hand, they are reshaping the external dimension, such as customer value propositions and newly created products and services (Coreynen et al., 2016; Loonam et al., 2018).

Most companies are not yet fully prepared to face the challenges of digital transformation, like fast-paced innovation, restructuring of business processes, or organizational structures, which must be tackled when digital technology is introduced to organizations and their employees (Almeida et al., 2020; Ashurst et al., 2008). The rapid changes arising from digitalization result in generating high levels of uncertainty within organizations (Kraus et al., 2021). It requires leadership and leaders to seize the digital opportunities within a highly dynamic business environment and to cope with it successfully (Coreynen et al., 2016; Kotter, 2000; Matt et al., 2015; Schwertner, 2017; Westerman et al., 2014b). Although digitalization activities and digital transformation seem to be closely connected to the personal skill-set of leaders within an organization, there is relatively little knowledge in the current state of research linking digitalization and leadership (de Araujo et al., 2021; Faix, 2020). Although initial scientific research on the topics of leadership characteristics for digital transformation and digital leadership has been published (El Sawy et al., 2016; Guzmán et al., 2020; Porfirio et al., 2021), the articles do not recognize the different digitalization dimensions of the companies' internal and external perspective. Whereas El Sawy et al. (2016) focus on the specific use case at the company LEGO, Guzmán et al. (2020) only outline leadership skills from the internal digitalization perspective. Furthermore, Porfirio et al. (2021) do not specifically describe leadership in their research.

As the research objective, the present study aims to address this research gap in required leadership skills and personality traits to succeed within the different companies' digitalization activities on

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the internal as well as the external dimension through an exhaustive literature review for 2011-2021, which an inductive analysis will further structure. The results of our research target to provide an overview of required leadership concepts for digitalization. In addition, we will outline specific leadership aspects for internal (direct customer interaction) and external (indirect customer interaction) digitalization activities.

The following paper is structured by first introducing the relevant subjects of digitization, digitalization, and digital transformation and further specifying the relevant digital terms for the companies' internal and external dimensions. The theory section is concluded by outlining our view on leadership in the context of digitalization prior to outlining our applied research approach of the literature review in the methods section. The results are presented as nine leadership themes with their specific applications of the internal and external digitalization dimension. Our paper closes by presenting conclusions of the research as well as resulting further research implications to advance the topic of leadership for companies' internal and external digitalization.

Theory

Terminology: Digitization, digitalization & digital transformation

Digitalization is one of the major trends changing society and business with significant research and practitioners' focus (Reis et al., 2018; Schallmo et al., 2020; Tihinen et al., 2016). Although its current attention, related terms are often used interchangeably without commonly accepted definitions (Schallmo et al., 2020).

The rapid development of information and communication technologies (ICT) enabled the incorporation of digital capabilities into previously purely physical products (Hirsch-Kreinsen, 2016; Yoo et al., 2012). The term digitization can be defined as converting analog information into digital data. Digitized information can be transferred quickly, cheaply, and accurately (Brennen & Kreiss, 2016). Digitization does not change value-creation activities (Verhoef et al., 2021). This technological shift enabled the creation of digital technologies such as the Internet of Things (IoT), cloud services and mobile applications, artificial intelligence, big data, analytics, social media, and embedded devices. All these means have the potential to change industries and societies fundamentally (Fitzgerald et al., 2014; Mihardjo et al., 2019; Vial, 2019).

Digitalization describes the change in existing processes, business models, and revenue streams that arise from digital technologies. Digitalization efforts are often implemented within projects and transform specific business operations (Bloomberg, 2022; Clerck, 2017; Verhoef et al., 2021). The application of digital technologies can occur in different areas of the company. Digitalization enables enhancing the customer experience, streamlines operational processes, and changes entire business models (Martínez et al., 2022; Nyagadza, 2022; Westerman et al., 2014a).

Digital transformation is the overarching concept that includes the digitalization process but goes beyond it. It has implications for the overall business strategy, organizational structure, and company culture (Bloomberg, 2022; Gartner, 2022; Verhoef et al., 2021; Vukšić et al., 2018). Besides integrating digital technologies, digital transformation results in organizational and social changes within companies (Reis et al., 2018). We summarized the three concepts in the following Fig. 1.

Therefore, we conclude that digitization and digital technologies can be seen as core elements. The technical process of encoding analog information into a digital format enables further digitalization activities but does not change value creation itself (Verhoef et al., 2021). With the change in business processes, products, or business models based on digital technologies, businesses move to the stage of digitalization. With the application of digitalization efforts, specific areas of a company can be improved and add additional value to a company's operation. Unlike digitalization, we see digital transformation as not focused on a specific area. It encompasses the continued efforts to change the organization's strategy, culture, and mindset. Ivančić et al. (2019) describe digital transformation as the continual process of increasing the extent of digitalization.

Internal and external digitalization

The increasing use of digital technologies significantly changes business and society (Dana et al., 2022). On a societal level, digitalization advances areas such as science and medicine, which helps to

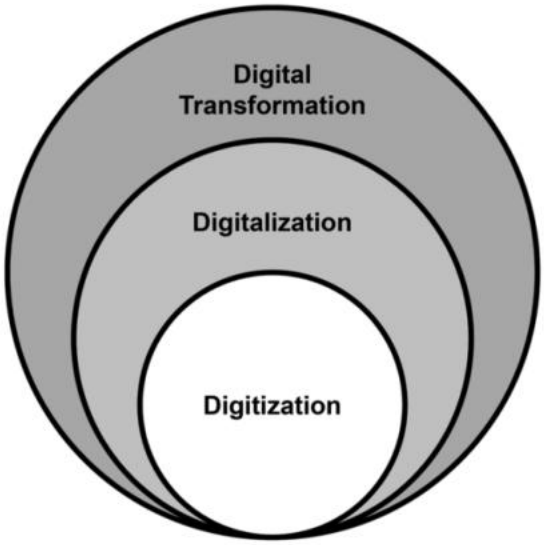

Fig. 1. Digitization, Digitalization, Digital Transformation (own depiction, based on Saarikko et al. (2020)).

ensure a better quality of life for individuals (Elmassah & Hassanein, 2022; Marti & Puertas, 2023). Furthermore, Martínez et al. (2022) highlight the positive environmental impact of digital technologies by ensuring more sustainable production and consumption. Generally, digital technologies are expected to boost productivity but also significantly change how employees work and collaborate through such topics as remote work (Schwarzmüller et al., 2018; Wrede et al., 2020).

From a business perspective, using digital technologies within the digitalization process can increase the company's internal efficiency, grow by adding value to the customer, and create new business models (Björkdahl, 2020; Ismail et al., 2017; Sathananthan et al., 2017). An area mentioned in existing research for internal digitalization is optimizing business processes that constitute companies' operations and supply chains (Bloomberg, 2022; Frank, Dalenogare, et al., 2019). With increased connectivity and the ability to analyze large amounts of data in real time, a reduction in setup needs, processing times, and errors are expected to result in higher productivity. The formation of so-called cyber-physical systems (CPS) is significantly changing the environment of manufacturing companies (Dalenogare et al., 2018; Jeschke et al., 2017; Wang et al., 2015). An often-discussed term in this relation is "Industry 4.0" (Frank, Dalenogare, et al., 2019; Kagermann et al., 2013; Lasi et al., 2014; Prem, 2015).

The term "digital business strategy" describes the broadened understanding of the IT role by combining business and IT strategies to integrate digital technologies (Bharadwaj et al., 2013; Brown & Brown, 2019; Holotiuk & Beimborn, 2017). Formerly viewed as a subordinate support function within the organization, the role of IT has changed significantly. Digital technologies are embedded in products and services. Thus they are entangled with the underlying IT infrastructure (Bharadwaj et al., 2013; Ukko et al., 2019). On the one hand, IT serves as an operational backbone to support the digitization of operations. On the other hand, building a platform that facilitates the rapid development and implementation of digital innovations is also required. This supports both efficiency gains through operational excellence and customer and service-centric innovation for which the proper setup of the IT backbone is the prerequisite (Sebastian et al., 2020; Vukšić et al., 2018).

From the external perspective, "servitization" gained importance for manufacturing companies within a scientific and practical context. In general, servitization can be seen as the process of increasing value through service and transforming a company offering product-centered to product-service systems (Frank, Mendes, et al., 2019; Kowalkowski et al., 2017; Martinez et al., 2017; Martín–Peña et al., 2018; Vandermerwe & Rada, 1988). Digital technologies and digitalization have been acknowledged as enablers and drivers of servitization (Martín-Peña et al., 2019; Vendrell-Herrero et al., 2017).

Creating new market offerings, products, or business processes from technologies can be described as digital innovations (Nambisan et al., 2017). Novel products or processes are established using new combinations of digital and physical components resulting in additional value creation (Hund et al., 2021; Yoo et al., 2010). Information technology (IT) is embodied in products and services and plays a significant role in enabling and constraining digital innovation to generate new IT-enabled products, processes, and services (Drechsler et al., 2020; Kohli & Melville, 2019; Fichman et al., 2014).

We identify whether the activity is directly associated with customer contact to distinguish between the internal and external dimensions of a company's digitalization activities. For example, the products or services and their development are directly associated with the customers. Internal activities such as manufacturing, supply chain, or setup of the IT backbone are indirectly associated with the customer and are therefore declared internally focused. Due to the origin of the manufacturing process, Industry 4.0 can be seen as internally oriented. Digital business strategy is IT-driven and thus requires internal business processes and infrastructures to be set up correctly. Thus, we also associate digital business strategy with internal digitalization activities. On the other side, digital servitization is directly associated with customer contact through digitizing the company's service offering. Although we associate the three former terms with the internal or external perspective, we acknowledge connections to the other dimension.

Digitalization and digital innovation cannot be directly associated with one perspective alone. Due to the broader nature and potential application within a company's internal or external dimension, digital innovation and digitalization projects can be in the company's internal or external perspective, depending on the context of its application.

Unlike the former terms project character, digital transformation differs within the organization. It is described as a social phenomenon that affects all aspects of organizations, which cannot be limited or categorized into a specific dimension (Reis et al., 2018). Therefore, we see digital transformation as an overarching concept influencing internal and external dimensions.

Leadership

Today's organizations are permeated with digital technologies and challenged with fast-paced and shortened innovation cycles (Ashurst et al., 2008; Yoo et al., 2012). The acronym *VUCA* stands for Volatility, Uncertainty, Complexity, and Ambiguity (Bennett & Lemoine, 2014). *VUCA* describes the unstable, dynamic, and rapidly changing world inherent in today's business environments (Lawrence, 2013). Leadership must respond to changing business requirements in an agile, fast, and flexible way (Passmore & O'Shea, 2010). Leadership is described and defined in many ways but has no "correct" definition (Bass, 2007; Yukl, 1998). As the concept of leadership has been known for many years (Kotterman, 2006), its application and orientation have developed over time depending on the boundary conditions (Larjovuori et al., 2018). Leadership is generally about setting direction, motivating, and aligning people (Kotter, 2000). Leaders present a vision and select, equip, train, and influence followers to achieve the organization's objectives (Winston & Patterson, 2006). Expressed differently, leadership is why people actively want to achieve a common goal (Mergenthaler, 2017). In addition, leaders must be able to adapt and support their organizations in coping with change (Kotter, 2000).

Digitalization is part of the current change in society and businesses and adds another layer of complexity due to the newly introduced digital technologies. Thus, digital transformation is part of organizations' overall challenges that need to be navigated by leaders. Initially established by Burns (1978) and further developed by Bass (1985), the theory of transformational leadership describes the leader as a change agent (Jackson & Parry, 2011; Khan, 2016). Not only because of the similar wording to digital transformation but transformational leadership concepts fit the requirements rather than more transactional or managerial approaches. Compared to management which typically controls and optimizes the status quo, leadership is about an innovative and creative future within complex and dynamic framework conditions (Faix, 2020; Kotter, 2000).

A research area that gained popularity within the scientific context is the combination of leadership and digitalization. Terms like "digital leadership" or "leadership in a digital age" have been created to describe new leadership challenges that arise from the process of digitalization and digital transformations of organizations (de Araujo et al., 2021; El Sawy et al., 2016; Khan, 2016; Neubauer et al., 2017; Prince, 2018). El Sawy et al. (2016, p.142) define digital leadership as "doing the right things for the strategic success of digitalization for the enterprise and its business ecosystem". De Araujo et al., (2021) use the definition of using an organization's digital assets to achieve business goals and organizational and individual levels to describe digital leadership.

Methods

A literature review was conducted to combine existing internal and external digitalization research with leadership. This approach provides an overview of the existing literature, synthesizes information, identifies patterns, and conceptualizes theoretical models based on existing literature (Snyder, 2019). Our approach followed a combination of the guidelines Kitchenham and Charters (2007) and Snyder (2019), proposing a three-stage process: planning, conducting the review, and documenting the review.

For the planning phase, the search strategy for identifying the relevant literature was developed (Snyder, 2019). First, the search terms related to leadership and relevant internal and external digital terms have been identified through our initial literature research (see theory section). Our approach includes six individual searches to link the digital terms to leadership. The Boolean operator "AND" was used to avoid receiving isolated results from the digital search terms or general research on the term "leadership" but to only identify scientific research that already connects digital terms and leadership.

The databases "ScienceDirect", "Web of Science (Core Collection, All Editions)" and "EBSCO Business Source Ultimate" were selected as they offer multidisciplinary content. This selection is required as the research topic is at the crossroads between multiple disciplines such as management, business, engineering, computer science, or information systems. While validating our review protocol, we further specified the search function within the databases to ensure optimal data output. For "ScienceDirect", the search terms option was chosen to be included in the title, abstract, or keywords. The option "All Fields" was used for "Web of Science"; for "EBSCO Business Ultimate Source Ultimate", the default option was applied.

Furthermore, the following inclusion and exclusion criteria have been developed during the planning phase of the review. Our results should be limited to journal articles and exclude books, conference proceedings, or other listed articles to ensure a high standard of scientific work due to the review process applied in journal papers. Our search options were limited to only "English" articles to ensure readability through the auditors. The review protocol further foresees that the initial set of documents is reduced to accessible articles, and we aim to remove duplicates from the individual search strings.

When the initial search was conducted, further exclusion criteria were defined based on the qualitative assessment of abstracts and resulting journal articles. Studies focusing on health care, education, or the public/government sector were excluded to limit the search results to the business environment and context. In addition, articles from the database search that do not combine research on leadership and digitalization were removed during the quality assessment. Additionally, we reiterated the process of excluding non-English articles and publication types based on the authors' review of the actual articles.

After the initial search, relevant articles referenced within the search results were added to answer the research question. Our quality criteria for the added papers were reduced to allow conference proceedings or other texts to allow context-specific contributions that otherwise would be missed.

The final set of articles was coded, whether they focused on the internal or external dimension of a company's digitalization. A third category, "organization" was established for articles that not solely focus on the internal or external perspective of digitalization but are related to the overarching digital transformation process that spans the entire organization. An inductive approach following Mayring (2000) was used to code and extract the described leadership traits from our final set of journals and cluster them based on identified patterns and themes. The themes provide a structure to summarize connected keywords related to the leadership aspects of digitalization. In addition, we outline leadership characteristics that are specifically described as relevant for either the internal or external dimension of digitalization.

Results

The database search yielded an initial amount of 1,115 articles based on the chosen criteria. Based on removing duplicates and eliminating not accessible articles, a total of 712 articles remained. Applying the defined quality criteria resulted in the exclusion of 650 articles after the qualitative review. Despite selecting only "English" in the original search string, four documents had to be removed through the quality assessment for language. Additionally, ten search results were deselected due to the publication style not being a journal article. Six hundred thirty-six articles did not pass the qualitative assessment because of the content. Thereof, 362 search results were not connected to the business environment. Most excluded articles were linked to the healthcare or education sector. Ultimately, the approach resulted in 62 articles by removing articles that did not specifically consider digital topics (64), articles not focusing on leadership at all (129), and articles that did not link the topics of digitalization and leadership (81). After identifying 30 additional relevant articles referenced in our search results, our final set amounted to 92. The described process is depicted in Fig. 3.

The remaining 92 articles were classified into three pre-defined categories "internal", "external", and "organization". The texts related to the internal dimension are mainly related to changes to the manufacturing environment (Industry 4.0) or the setup of the IT environment. The main external perspective themes are associated with developing and marketing new digital products and business models or approaching customers within the digital environment. The largest share of identified articles does not explicitly emphasize a company's external or internal perspective. In contrast, they focus on the overall digital transformation process, which overarches the entire company, classifying them as "organization".

As displayed in Table 1, most of the literature review results (57 articles, i.e. 62%) are related to "organization". Twenty-three texts (25%) were classified as "internal". The least mentioned perspective in current scientific work is "external", with 12 articles (13%). This led to the first conclusion that the leadership aspect of the current literature focuses on digital transformation and its accompanying cultural and organizational impacts on a company. Due to the overarching nature of digital transformation, those articles may still include aspects related to the internal or external dimension. The search term "Industry 4.0" represented the majority of articles linking the internal perspective and leadership. Our literature research indicates that there is currently no scientific research on the leadership aspect of digital servitization. Table 2 presents the identified keywords summarized by nine themes based on the inductive analysis. In addition, specific leadership aspects for the internal and external digitalization perspective are outlined.

Vision & customer centricity

Leaders in a digital world must have a vision of transforming their company (Westerman et al., 2014b). A clear vision that gives direction and purpose to the company and its employees is a prerequisite for digital transformation (Kazim, 2019; Kwiotkowska et al., 2021).

Table 1
Article distribution per dimension.

Dimension	*N* of articles	Percentage
Organization	57	62%
Internal	23	25%
External	12	13%

Table 2
Results of inductive analysis.

Themes	General aspects		Specific internal aspects	Specific external aspects	Sources
Vision & customer centricity	• Creativity • Critical thinking • Curiosity • Customer orientation • Foresight in emerging trends • Innovation	• Future-oriented • Growth mindset • Problem-solving • Think outside the box • Visionary	• Customer centricity for internal processes • Customer-oriented IT setup	• Customer-oriented product & business model development • Product development based on solving customer needs • Include technology trends in new products/business models	(Alade & Windapo, 2019, 2021; Berman, 2012; Breuer & Szillat, 2019; Chau et al., 2021; Chuang & Graham, 2020; Danoesastro et al., 2020; de Araujo et al., 2021; Diller et al., 2020; Eberl & Drews, 2021, 2021; El Sawy et al., 2016; Fan et al., 2021; Garbellano & Da Veiga, 2019; Guinan et al., 2019; Guzmán et al., 2020; Helming et al., 2019; Herold, 2016; Hyek & Nendick, 2014; Imran et al., 2020, 2021; Ivančić et al., 2019; Jakubik & Berazhny, 2017; Jesse, 2019; Kane, 2019; Kane et al., 2015, 2016, 2017, 2018, 2019; Kazim, 2019; Kohli & Johnson, 2011; Kraft, 2019; Kwiotkowska et al., 2021; Larjovuori et al., 2018; Li et al., 2016; Marnewick & Marnewick, 2020; Mdluli & Makhupe, 2017; Meier et al., 2017; Michna & Kmieciak, 2020; Mihardjo et al., 2019; Nadella & Euchner, 2018; Nasution et al., 2020; Neubauer et al., 2017; Oberer & Erkollar, 2018; Philip, 2021; Philip & Gavrilova Aguilar, 2021; Porfirio et al., 2021; Rattanawiboonsom & Chayatthatto, 2018; Saabye et al., 2020; Sainger, 2018; Schmidt, 2019; Schwarzmüller et al., 2018; Shah & Patki, 2020; Shamim et al., 2016; Sia et al., 2016; Singh & Hess, 2017; Sony et al., 2020; Sow & Aborbie, 2018; Staffen & Schoenwald, 2016; Tumbas et al., 2017; Vrana & Singh, 2021; Westerman et al., 2014b; Wrede et al., 2020; Zulu & Khosrowshahi, 2021)
Change & VUCA readiness	• Adaptivity • Agility • Change readiness • Embrace change • Flexibility • Fast decision making	• Manage uncertainty • Openness • Speed • Tolerance for ambiguity • Transformational leadership	• Agile IT setup that can quickly adapt to business demands	• Adjusting to change and responsive to market and technological shifts • Quick reactions to changing customer needs/expectations	(Alade & Windapo, 2019, 2021; Alos-Simo et al., 2017; Bag et al., 2021; Bennis, 2013; Berman & Marshall, 2014; Bolden & O'Regan, 2016; Bolte et al., 2018; Breuer & Szillat, 2019; Brock & von Wangenheim, 2019; Chuang & Graham, 2020; Cresnar & Nedelko, 2020; Danoesastro et al., 2020; de Araujo et al., 2021; Dery et al., 2017; Diller et al., 2020; Eberl & Drews, 2021; El Sawy et al., 2016; Fan et al., 2021; Foerster-Metz et al., 2018; Gaffley & Pelser, 2021; Garbellano & Da Veiga, 2019; Gfrerer et al., 2021; Gierlich-Joas et al., 2020; Guinan et al., 2019; Gurumurthy & Schatsky, 2019; Guzmán et al., 2020; Helming et al., 2019; Herold, 2016; Hyek & Nendick, 2014; Imran et al., 2021; Ivančić et al., 2019; Jakubik & Berazhny, 2017; Jesse, 2019; Kane, 2019; Kane et al., 2015, 2016, 2017, 2019; Kazim, 2019; Kohli & Johnson, 2011; Kraft, 2019; Kwiotkowska et al., 2021; Larjovuori et al., 2018; Li et al., 2016; Marnewick & Marnewick, 2020; Matsunaga, 2021; Mdluli & Makhupe, 2017, 2017; Meier et al., 2017; Michna & Kmieciak, 2020; Mihai & Cretu, 2019; Nasution et al., 2020; Neubauer et al., 2017; Oberer & Erkollar, 2018; Philip, 2021; Philip & Gavrilova Aguilar, 2021; Porfirio et al., 2021; Rüth & Netzer, 2020; Saabye et al., 2020; Salvetti & Bertagni, 2020; Schmidt, 2019; Schwarzmüller et al., 2018; Shah & Patki, 2020; Sia et al., 2016; Singh & Hess, 2017; Sony et al., 2020; Sow & Aborbie, 2018; Staffen & Schoenwald, 2016; Tumbas et al., 2017; Vrana & Singh, 2021; Wrede et al., 2020; Zulu & Khosrowshahi, 2021)

(*continued on next page*)

Table 2 (*Continued*)

Themes	General aspects		Specific internal aspects	Specific external aspects	Sources
Flat hierarchies, decentralized decision making & empowerment	• Ambidextrous organization • Autonomy • Decision making at a low level • Delegation • Empowerment	• Entrepreneurial • Flat hierarchies • Participation • Startup mentality	• Machine operators to make decisions based on available data • More direct interaction across organizational layers	• Decision making for those closest to the customer • Separate business units for testing and launching new digital innovations	(Alade & Windapo, 2019; Alos-Simo et al., 2017; Bauer et al., 2015; Bolden & O'Regan, 2016; Bregenzer & Jimenez, 2021; Chuang & Graham, 2020; Danoesastro et al., 2020; de Araujo et al., 2021; Eberl & Drews, 2021; El Sawy et al., 2016; Foerster-Metz et al., 2018; Gaffley & Pelser, 2021; Garbellano & Da Veiga, 2019; Gfrerer et al., 2021; Guinan et al., 2019; Helming et al., 2019; Hesse, 2018; Imran et al., 2020, 2021; Jakubik & Berazhny, 2017; Jesse, 2019; Kane, 2019; Kane et al., 2016, 2018, 2019; Kazim, 2019; Kraft, 2019; Larjovuori et al., 2018; Li et al., 2016; Lin et al., 2020; Marnewick & Marnewick, 2020; Matsunaga, 2021; Mdluli & Makhupe, 2017; Nadella & Euchner, 2018; Oberer & Erkollar, 2018; Röth & Netzer, 2020; Saabye et al., 2020; Salvetti & Bertagni, 2020; Schmidt, 2019; Schwarzmüller et al., 2018; Shah & Patki, 2020; Shamim et al., 2016; Sia et al., 2016; Sow & Aborbie, 2018; Staffen & Schoenwald, 2016; Vrana & Singh, 2021; Wrede et al., 2020)
Digital savviness & ability to work with digital technologies	• Big data • Data analysis • Data based decision making	• Digital understanding • Digital communication skills • Social media	• Usage of machine data for manufacturing & supply chain optimization • Use social media and company platforms for internal communications and employee interaction	• Usage of consumer & customer data • Personalization of marketing and products based on data analytics • Use social media to engage with external stakeholders (customers, society)	(Alade & Windapo, 2021; Bennis, 2013; Bolden & O'Regan, 2016; Breuer & Szillat, 2019; Darics, 2020; Dery et al., 2017; Eberl & Drews, 2021, 2021; El Sawy et al., 2016; Foerster-Metz et al., 2018; Gaffley & Pelser, 2021; Gfrerer et al., 2021; Gurumurthy & Schatsky, 2019; Guzmán et al., 2020; Helming et al., 2019; Hyek & Nendick, 2014; Imran et al., 2020, 2021; Ivančić et al., 2019; Jesse, 2019; Kane, 2019; Kane et al., 2015, 2017, 2019; Kazim, 2019; Kraft, 2019; Kwiotkowska et al., 2021; Li et al., 2016; Mdluli & Makhupe, 2017; Oberer & Erkollar, 2018; Saabye et al., 2020; Salvetti & Bertagni, 2020; Schwarzmüller et al., 2018; Shah & Patki, 2020; Tumbas et al., 2017; Westerman et al., 2014b; Wrede et al., 2020)
Theme	General aspects		Specific internal aspects	Specific external aspects	Sources
Partnering & ecosystems	• Co-creation • Communities • Collaboration with freelancers • Crowdsourcing	• Ecosystems • Networking • Partnering • Work with the scientific community	• Collaboration with suppliers to improve current supply chain processes • Freelancers for IT developments	• Collaboration/co-creation with customers for digital product developments • Crowdsourcing for new product ideas	(Aghimien et al., 2020; Alade & Windapo, 2021; Bauer et al., 2015; Berman, 2012; Berman & Marshall, 2014; Bolden & O'Regan, 2016; Brock & von Wangenheim, 2019; Chau et al., 2021; Chuang & Graham, 2020; Cresnar & Nedelko, 2020; Danoesastro et al., 2020; de Araujo et al., 2021; Dery et al., 2017; El Sawy et al., 2016; Fan et al., 2021; Foerster-Metz et al., 2018; Gaffley & Pelser, 2021; Garbellano & Da Veiga, 2019; Guinan et al., 2019; Gurumurthy & Schatsky, 2019; Guzmán et al., 2020; Haddud & McAllen, 2018; Herold, 2016; Hyek & Nendick, 2014; Imran et al., 2021; Ivančić et al., 2019; Jakubik & Berazhny, 2017; Jesse, 2019; Kane et al., 2015, 2016, 2017, 2018, 2019; Kwiotkowska et al., 2021; Larjovuori et al., 2018; Li et al., 2016; Marnewick & Marnewick, 2020; Mdluli & Makhupe, 2017; Nadella & Euchner, 2018; Schwarzmüller et al., 2018; Sousa & Rocha, 2019; Staffen & Schoenwald, 2016; Vrana & Singh, 2021; Wrede et al., 2020)
Experimentation & risk-taking	• Experimentation • Fast failing • Iterative development	• Learning from mistakes • Risk-taking • Trial and error	• Experiment with new technologies and new approaches to work	• Iterative product and business model development (trial & error)	(Alos-Simo et al., 2017; Bennis, 2013; Bolden & O'Regan, 2016; Bolte et al., 2018; Breuer & Szillat, 2019; Brock & von Wangenheim, 2019; Cresnar & Nedelko, 2020; Danoesastro et al., 2020; de Araujo et al., 2021; Dery et al., 2017; Diller et al., 2020; Eberl & Drews, 2021; El Sawy et al., 2016; Gaffley & Pelser, 2021; Garbellano & Da Veiga, 2019; Guinan et al., 2019; Gurumurthy & Schatsky, 2019; Guzmán et al., 2020;

(*continued on next page*)

Table 2 (*Continued*)

Themes	General aspects		Specific internal aspects	Specific external aspects	Sources
					Herold, 2016; Hyek & Nendick, 2014; Imran et al., 2020, 2021; Kane, 2019; Kane et al., 2015, 2016, 2017, 2018, 2019; Kazim, 2019; Kwiotkowska et al., 2021; Larjovuori et al., 2018; Mdluli & Makhupe, 2017; Meier et al., 2017; Michna & Kmieciak, 2020; Nasution et al., 2020; Philip & Gavrilova Aguilar, 2021; Saabye et al., 2020; Schmidt, 2019; Shah & Patki, 2020; Sousa & Rocha, 2019; Staffen & Schoenwald, 2016; Wrede et al., 2020)
Teamwork, work-life balance & workplace	• Coaching & Mentoring • Collaboration • Cross-functional teams • Flexibility for working time & place • Health management awareness • Job rotation • Knowledge sharing	• Lifelong learning • Talent attraction & development • Teamwork • Virtual teams • Work live balance	• Close collaboration between IT and business for digital process improvements • Providing training to employees to work with new digital technologies • Ensure proper IT setup for virtual collaboration	• Close collaboration between IT and business for digital product development • Cross-functional teams for product/business model development	(Alade & Windapo, 2019; Babin & Grant, 2019; Bolden & O'Regan, 2016; Bolte et al., 2018; Bregenzer & Jimenez, 2021; Breuer & Szillat, 2019; Chau et al., 2021; Chuang & Graham, 2020; Cresnar & Nedelko, 2020; Danoesastro et al., 2020; de Araujo et al., 2021; Dery et al., 2017; Eberl & Drews, 2021; El Sawy et al., 2016; Fan et al., 2021; Foerster-Metz et al., 2018; Gaffley & Pelser, 2021; Garbellano & Da Veiga, 2019; Gfrerer et al., 2021; Guinan et al., 2019; Gurumurthy & Schatsky, 2019; Guzmán et al., 2020; Herold, 2016; Imran et al., 2020, 2021; Ivančić et al., 2019; Jakubik & Berazhny, 2017; Jesse, 2018, 2019; Kane, 2019; Kane et al., 2015, 2016, 2017, 2018, 2019; Kazim, 2019; Kohli & Johnson, 2011; Kwiotkowska et al., 2021; Larjovuori et al., 2018; Li et al., 2016; Marnewick & Marnewick, 2020; Mdluli & Makhupe, 2017; Meier et al., 2017; Michna & Kmieciak, 2020; Mihardjo et al., 2019; Nadella & Euchner, 2018; Nasution et al., 2020; Oberer & Erkollar, 2018; Philip, 2021; Rattanawiboonsom & Chayatthatto, 2018; Saabye et al., 2020; Salvetti & Bertagni, 2020; Schmidt, 2019; Schwarzmüller et al., 2018; Shamim et al., 2016; Singh & Hess, 2017; Sony et al., 2020; Sow & Aborbie, 2018; Staffen & Schoenwald, 2016; Tumbas et al., 2017; Vrana & Singh, 2021; Wrede et al., 2020)
Humility, social & soft skills	• Accountability • Authenticity • Democratic • Emotional intelligence • Empathy • Feedback • Inspiration	• Motivation • Openness • Resilience • Servant leadership • Soft skills • Supportive • Transparency • Trust	• Generate trust in employees to cope with job changes/replacement due to digitalization	• Transparency towards customers	(Alade & Windapo, 2019; Babin & Grant, 2019; Bennis, 2013; Berman & Marshall, 2014; Bolden & O'Regan, 2016; Bolte et al., 2018; Bregenzer & Jimenez, 2021; Brock & von Wangenheim, 2019; Chau et al., 2021; Chuang & Graham, 2020; Cresnar & Nedelko, 2020; Darics, 2020; de Araujo et al., 2021; Dery et al., 2017; Eberl & Drews, 2021; El Sawy et al., 2016; Foerster-Metz et al., 2018; Garbellano & Da Veiga, 2019; Gfrerer et al., 2021; Gierlich-Joas et al., 2020; Guinan et al., 2019; Guzmán et al., 2020; Haddud & McAllen, 2018; Herold, 2016; Hesse, 2018; Imran et al., 2021; Ivančić et al., 2019; Jakubik & Berazhny, 2017; Jesse, 2018; Kane et al., 2016; Kazim, 2019; Kwiotkowska et al., 2021; Larjovuori et al., 2018; Li et al., 2016; Lin et al., 2020; Marnewick & Marnewick, 2020; Matsunaga, 2021; Mdluli & Makhupe, 2017; Meier et al., 2017; Nasution et al., 2020; Neubauer et al., 2017; Philip, 2021; Philip & Gavrilova Aguilar, 2021; Schmidt, 2019; Schwarzmüller et al., 2018; Shah & Patki, 2020; Shamim et al., 2016; Sia et al., 2016; Singh & Hess, 2017; Sow & Aborbie, 2018; Staffen & Schoenwald, 2016; Vrana & Singh, 2021; Wrede et al., 2020)
Cultural awareness & diversity	• Cultural awareness • Diversity & Inclusion	• Ethical • Multigenerational	• Ability to cope with a multigenerational workforce • Cultural awareness for multicultural teams	• Understanding needs from culturally different customers	(Bauer et al., 2015; Chuang & Graham, 2020; Cresnar & Nedelko, 2020; Eberl & Drews, 2021, 2021; El Sawy et al., 2016; Fan et al., 2021; Garbellano & Da Veiga, 2019; Gierlich-Joas et al., 2020; Guinan et al., 2019; Herold, 2016; Kazim, 2019; Lin et al., 2020; Rüth & Netzer, 2020; Schmidt, 2019; Schwarzmüller et al., 2018; Sow & Aborbie, 2018)

For this, the leader must envision and understand how digital technologies contribute to the organization's digital future (Imran et al., 2020). The vision must be transcribed and translated to be tangible and inspiring for the whole organization (Guzmán et al., 2020; Marnewick & Marnewick, 2020). Therefore, communicating the vision is a critical leadership trait for digitalization to achieve a shared and common vision between the leader and the employees (Ivančić et al., 2019; Larjovuori et al., 2018; Philip & Gavrilova Aguilar, 2021; Sia et al., 2016). Besides the vision's communication, leaders must provide the necessary abilities to execute it through strategies and tactics (Alade & Windapo, 2019; Kazim, 2019; Larjovuori et al., 2018). Leaders must possess visionary competencies (Alade & Windapo, 2019; Breuer & Szillat, 2019; Imran et al., 2020; Kazim, 2019). These include anticipating markets and trends (Kane et al., 2019). By constantly scanning the internal and external environment, the digital leader must look beyond existing strategies and procedures to guide the business in response to the changes (Kane et al., 2019; Neubauer et al., 2017).

Leaders must enable and promote creativity to create new business models based on digital technologies (Larjovuori et al., 2018; Mihardjo et al., 2019; Philip, 2021). In addition, scholars describe curiosity and out-of-the-box thinking as relevant attributes to continuously challenge the status quo and prepare the organization for the digital transformation (de Araujo et al., 2021; Kane et al., 2016; Mdluli & Makhupe, 2017; Mihardjo et al., 2019). When describing the challenges and opportunities of digital transformation, Microsoft's CEO Satya Nadella speaks about a "growth mindset" as a central element of the company's culture (Nadella & Euchner, 2018). The competencies above are mentioned to promote and foster innovation (Guzmán et al., 2020; Kane et al., 2015). Leaders should act as active drivers of innovation and think like innovators within the digital environment (Kane et al., 2019; Mdluli & Makhupe, 2017; Staffen & Schoenwald, 2016).

Besides a strong focus on innovation, prioritizing customers' needs are a primary driver for digitalization (Larjovuori et al., 2018; Oberer & Erkollar, 2018; Westerman et al., 2014a). Leadership is impactful in attaining customer-centricity within the digital transformation (Imran et al., 2021; Larjovuori et al., 2018). On the one hand, understanding the customers' needs and offering solutions in terms of new products, services, processes, or business models represents an aspect of the external dimension of digitalization (Li et al., 2016). On the other hand, customer involvement in business processes and improving customer experience by streamlining internal processes is recommended (Ivančić et al., 2019; Tumbas et al., 2017). In addition to the internal perspective of digitalization, IT/IS leaders must have a customer focus to bring value to the organization (Kohli & Johnson, 2011).

Change & VUCA readiness

Due to today's unpredictable business environment, leaders must accept that change is constant (Kane et al., 2019; Neubauer et al., 2017). Salvetti & Bertagni (2020) describe digital transformation process as inherently uncertain. Therefore, leaders should possess excellent tolerance for ambiguity and be comfortable with uncertainty and complexity. This means being able to respond to the challenges that arise in a *VUCA* world, especially driven by digital technologies (de Araujo et al., 2021; Guzmán et al., 2020; Kazim, 2019; Mihai & Cretu, 2019; Schwarzmüller et al., 2018; Staffen & Schoenwald, 2016). In conclusion, sticking to the overall vision while adapting in the short term to changing environments is a critical competency for leaders (Neubauer et al., 2017). The ability to adapt, especially in adequately responding to change, is another quality frequently described in existing literature (Shah & Patki, 2020). Similarly, leaders should be flexible to enable innovation and support their employees during the digital transformation process (Bolte et al., 2018; Kane et al., 2017; Kraft, 2019; Sow & Aborbie, 2018).

For leaders to benefit from the changes arising from digital technologies and the *VUCA* environment, openness to new ideas and an open mindset from the leader are needed (Guzmán et al., 2020; Imran et al., 2021; Neubauer et al., 2017). This open-mindedness is directly linked with the ability to embrace change (Kane et al., 2019). Change can be described as one of the central leadership elements of digital transformation. Leaders should embrace change and create an environment for change, foster a culture of change and drive change toward the desired direction (Sainger, 2018; Schmidt, 2019; Zulu & Khosrowshahi, 2021). The leader acts as a change agent and removes hurdles to achieving change (Sainger, 2018; Staffen & Schoenwald, 2016). Especially relevant from the external perspective of digitalization is the attribute to adapt and respond to market and technological shifts (Mdluli & Makhupe, 2017).

Due to the volatility and speed of the digital markets, the pace is vital to react to changes fast and adequately. Fast decision-making and execution are proposed in the existing literature to keep up with the speed of the digital world (Berman, 2012; Larjovuori et al., 2018; Neubauer et al., 2017). A concept closely connected to fast-changing digital markets is agility (Hyek & Nendick, 2014). Kohli and Johnson highlight a flexible, agile, and quickly scaling IT function to meet business demands for the internal dimension (Kohli & Johnson, 2011). On the external side of digitalization, responsiveness to changes arising from market and technological shifts is essential for leaders to succeed (Mdluli & Makhupe, 2017).

Flat hierarchies, decentralized decision-making & empowerment

Organizations need to change their hierarchical structure and decision-making processes to keep up with the pace and complexity of the fast-changing digital environment (Foerster-Metz et al., 2018). In the digital VUCA world, the amount and complexity of required decisions increase exponentially (Imran et al., 2020). Therefore, current literature recommends delegating decision-making down the hierarchy (Bauer et al., 2015; El Sawy et al., 2016; Imran et al., 2020). Employees should be granted more opportunities to work autonomously within the given boundaries by the leaders (Bregenzer & Jimenez, 2021; Danoesastro et al., 2020; Kane et al., 2018; Schwarzmüller et al., 2018). The leadership role changes from making the decisions to enabling the employees to make the decisions and providing the necessary resources (Gfrerer et al., 2021). Besides more agile decision-making, the empowerment of lower hierarchies is also expected to increase the motivation of employees (Alade & Windapo, 2019; Balan & Cavendish, 2017; Eberl & Drews, 2021). In addition, empowered employees in the decision-making process are more likely to be more innovative and receptive to cultural change (Guinan et al., 2019; Sainger, 2018).

From an organizational viewpoint, the identified articles from our literature research propose flat hierarchies and organizational structures as supportive of digital transformations (Chuang & Graham, 2020; El Sawy et al., 2016; Foerster-Metz et al., 2018; Salvetti & Bertagni, 2020; Schwarzmüller et al., 2018; Shamim et al., 2016). The flat structure reduces the distance between employees and the top management, allowing quicker communication and collaboration across hierarchical layers. (Shamim et al., 2016). Leaders and employees should actively act as entrepreneurs to promote innovation (Bauer et al., 2015; Foerster-Metz et al., 2018; Jesse, 2018).

Digital savviness & ability to work with digital technologies

Digitalization and digital transformation are centered around the use of digital technologies. Although leaders do not need to have technical skills like programming, it is recommended to understand

digital technologies, which can influence business models and operations (Imran et al., 2020; Kane et al., 2015). We identified terms like "digital fluency," "digital savviness," or "digital literacy" as commonly used terms to describe the leader's understanding of emerging digital technologies (Bolden & O'Regan, 2016; Eberl & Drews, 2021; Kane et al., 2015, 2019).

Digitalization generally increases the number of available data points throughout the organization and its environment. Therefore, successful leaders require the ability to analyze data and undertake data-driven decision-making (Imran et al., 2021; Kwiotkowska et al., 2021). On the external side, data analytics can collect and process market and customer information (Li et al., 2016). For example, value can be created by personalizing marketing and products (El Sawy et al., 2016). From an internal view of the organization, data usage is one of the critical elements of Industry 4.0 by optimizing manufacturing or supply chain processes based on available real-time information. Social media and digital communication can be described as the second crucial digital technology critical to master for leaders in the digital age (Darics, 2020). Social media can engage with different stakeholders, such as customers, consumers, partners, and employees (Eberl & Drews, 2021). Interacting with customers on the external dimension can support discovering customers' concerns and needs and a more proactive response to customer service (El Sawy et al., 2016; Kazim, 2019). Internally, integrating so-called enterprise social media platforms into the regular workday can enhance collaboration by sharing information between leaders and employees.

Partnering & ecosystems

In their definition of digital leadership, El Sawy et al. (2016) describe it as doing the right things for the strategic success of digitalization for the company and its business ecosystem. They refined the original definition of Warren Bennis by adding the term ecosystem due to its increased importance in today's connected world. Our literature review concludes that working beyond organizational boundaries, such as partnering and co-creation within networks and ecosystems, is perceived as necessary in the digital environment. Therefore, transitioning from traditional hierarchical structures to network structures between the company, suppliers, customers, and other stakeholders such as universities or start-ups is a significant task for leaders (de Araujo et al., 2021; Ivančić et al., 2019). On the one hand, the rapidly changing digital environment requires companies to engage in partnerships and ecosystems to keep up with new developments (Larjovuori et al., 2018). On the other hand, collaboration beyond organizational limits is needed to increase the organization's ability to innovate and grow (Gurumurthy & Schatsky, 2019).

Collaboration with the "outside world" can be achieved through different avenues and impact the internal or external dimension of the company's digitalization efforts. On the internal side, establishing partnerships and close collaboration with suppliers are good examples (Chau et al., 2021; Imran et al., 2021). Another aspect mentioned in the internal context of an organization is the use of freelancers or contractors. Especially in the programming and the setup of the IT backbone area, a core staff can be augmented by outsourcing specific work packages and increasing the organization's flexibility (Foerster-Metz et al., 2018; Li et al., 2016). The suggested leadership actions on the external dimension are related to customer relationships and joint product and business model developments. A term often used in the articles we systematically retrieved from the literature is "co-creation". Leaders must promote close collaboration with partners and customers (Larjovuori et al., 2018). It allows a customer-centric process to generate value and innovations (Imran et al., 2021; Staffen & Schoenwald, 2016). In addition, we also identify that a close relationship with the academic community and universities is recommended to have additional partners to pursue digital innovations (Alade & Windapo, 2021; Ivančić et al., 2019; Kane et al., 2018).

Experimentation & risk-taking

We identify the common argument that leaders are required to be willing to experiment (El Sawy et al., 2016; Imran et al., 2021; Kane et al., 2018; Mdluli & Makhupe, 2017), create conditions to experiment (de Araujo et al., 2021; Diller et al., 2020; Guinan et al., 2019; Kazim, 2019), encourage experimentation (Kane et al., 2017; Schmidt, 2019), and implement a culture of experimentation (Gurumurthy & Schatsky, 2019; Imran et al., 2021; Kane, 2019; Larjovuori et al., 2018) when advancing their company through digitalization. It is primarily the leader's task to empower their teams (Alos-Simo et al., 2017; Guinan et al., 2019) and create safe environments for trial and error (Philip & Gavrilova Aguilar, 2021). Not all started experiments will result in successful innovations, so leadership needs to have the appropriate attitude towards failure, such as embracing and accepting the risk of failure (Kane et al., 2017; Saabye et al., 2020). An important aspect is handling failure constructively by consciously and systematically learning from mistakes and improving (Bennis, 2013; Bolden & O'Regan, 2016; Imran et al., 2020; Kane et al., 2018; Larjovuori et al., 2018). Another aspect frequently mentioned in our identified articles is the requirement to fail fast (Imran et al., 2020; Kazim, 2019; Shah & Patki, 2020). The faster organizations can close the cycle of experimenting and failing, the better the opportunities to learn from failed trials and ultimately succeed in digital innovations due to the increased experience gained.

An example of how these concepts can be applied to the external digitalization perspective can be seen in iterative digital developments (El Sawy et al., 2016; Guinan et al., 2019; Kane et al., 2018). Products or prototypes can be delivered to the market quickly, allowing consumers to provide feedback (Guinan et al., 2019). An instance where the concepts are essential for internal leadership is experimentation with new technologies and approaches to work, including a new approach to the workplace or digital collaboration tools (Dery et al., 2017). Our literature review reveals that leaders need to be willing to act boldly (Breuer & Szillat, 2019; Hyek & Nendick, 2014; Kane et al., 2015; Michna & Kmieciak, 2020), take risks, and also encourage their employees to overcome risk aversion during the digitalization process (Eberl & Drews, 2021; Kane et al., 2017; Kwiotkowska et al., 2021; Sousa & Rocha, 2019).

Teamwork & working environment

Leaders must establish collaborative environments and a culture that supports collaboration (Imran et al., 2021; Kane et al., 2015). Several of our identified research articles highlight the connection between collaboration and innovation, ultimately leading to success in the digital environment (Dery et al., 2017; Kane et al., 2017; Mdluli & Makhupe, 2017; Mihardjo et al., 2019; Oberer & Erkollar, 2018; Vrana & Singh, 2021). A specific aspect our focus articles emphasize is a cross-functional collaboration (Eberl & Drews, 2021; Imran et al., 2021; Kazim, 2019; Philip, 2021; Singh & Hess, 2017; Staffen & Schoenwald, 2016) or cross-functional team setups (Danoesastro et al., 2020; Garbellano & Da Veiga, 2019; Guinan et al., 2019; Jesse, 2019; Kane, 2019; Kane et al., 2017, 2018; Schwarzmüller et al., 2018). Leaders can choose diversified team constitutions with members from different functional areas to encounter complex problems (Imran et al., 2021; Kane et al., 2017; Staffen & Schoenwald, 2016). A specific example where cross-functional team setups can be helpful from the external perspective is the joint development of new digital products or business models. Integrating different functions such as sales, IT, or supply chain can enrich product development with different perspectives and inputs. An additional case where organizations can benefit from cross-functional setups is the close collaboration and integration of the IT function into the business processes.

Our identified articles point out the importance of teamwork (Mdluli & Makhupe, 2017; Schwarzmüller et al., 2018; Sony et al.,

2020), team-oriented leadership approaches (Guzmán et al., 2020; Oberer & Erkollar, 2018), and team-building skills for leaders (Kazim, 2019; Rattanawiboonsom & Chayatthatto, 2018; Schwarzmüller et al., 2018; Shamim et al., 2016; Sony et al., 2020). Talent attraction (Chuang & Graham, 2020; Kane et al., 2016; Staffen & Schoenwald, 2016; Vrana & Singh, 2021), development (Alade & Windapo, 2019; Kane, 2019), and management (Guinan et al., 2019; Gurumurthy & Schatsky, 2019) are of high importance within the organization to enable innovative and high-performance teams (Jakubik & Berazhny, 2017; Mdluli & Makhupe, 2017). Digital technologies require skillsets for which the market of skillful individuals is relatively minor (Danoesastro et al., 2020; Wrede et al., 2020). Therefore, on the one hand, leaders need to ensure that their organizations are attractive to those scarce talents. On the other hand, companies must develop their existing talents and bring the best out of them (Kane et al., 2019).

One aspect mentioned in our identified literature is coaching and mentoring (Alade & Windapo, 2019; Eberl & Drews, 2021; Imran et al., 2021; Larjovuori et al., 2018; Meier et al., 2017; Saabye et al., 2020; Schmidt, 2019; Shamim et al., 2016; Staffen & Schoenwald, 2016). Rather than solving the issue itself, leaders provide perspective for problem-solving and have the employee solve the problems autonomously and intervene if required (Schwarzmüller et al., 2018). The task of leadership shifts more towards providing the necessary information and removing arising impediments (Guinan et al., 2019).

Digital leaders are required to establish a culture of knowledge sharing and learning. For the learning aspect, our identified literature mentions the concept of "lifelong learning" (Eberl & Drews, 2021; Gfrerer et al., 2021; Jesse, 2018; Kwiotkowska et al., 2021; Meier et al., 2017; Schwarzmüller et al., 2018) or "continuous learning" (de Araujo et al., 2021; Guinan et al., 2019; Kane et al., 2018; Mihardjo et al., 2019) to emphasize the ongoing efforts to expand knowledge within the organization. From a training perspective, it is the task of the leader to provide adequate opportunities for employees to acquire and develop the essential skills required for the digital future (Wrede et al., 2020).

Digital technologies enable concepts such as remote work, home office, and new digital communication and collaboration tools (Bregenzer & Jimenez, 2021; Kazim, 2019; Wrede et al., 2020). The working environment will shift towards increased flexibility regarding working hours, mobility, and place of work, especially expected by the younger generation of employees (El Sawy et al., 2016). This development requires leaders to deal with virtual teams and related digital communication tools (Mdluli & Makhupe, 2017; Schwarzmüller et al., 2018). The constant connectedness to work through digital tools is why leaders must pay attention to health management in the digital working environment (Schwarzmüller et al., 2018). The retrieved articles from our literature review highlight leadership's responsibility for employees' work-life balance, health, and stress levels by providing the necessary working environment (Bregenzer & Jimenez, 2021; Jakubik & Berazhny, 2017).

Humility, employee orientation & soft skills

The themes mentioned above for successful leadership in digital transformations are supported by the leader's general attitude and mindset. People must balance technical skills and digital understanding or employee-oriented leadership (Eberl & Drews, 2021; Gierlich-Joas et al., 2020; Kazim, 2019; Kwiotkowska et al., 2021; Vrana & Singh, 2021). People-oriented leadership can be understood as putting people at the center (Jesse, 2019). Based on the empowerment and independent decision-making ability of the employees, it is the leader's task to establish a supportive culture, provide the necessary resources, remove impediments, and enable employees to reach the organization's digital transformation goals (Brock & von Wangenheim, 2019; Guinan et al., 2019; Kane et al., 2017; Larjovuori et al., 2018; Philip, 2021).

This autonomy requires the leaders to "let go" and trust in the competencies of employees who are more knowledgeable in their area of expertise than the leader (Schwarzmüller et al., 2018). The topic of trust is frequently mentioned in our identified articles but can be seen from two different perspectives. On the one hand, leaders need to trust in their teams and employees (Bolte et al., 2018; Foerster-Metz et al., 2018; Guzmán et al., 2020; Sow & Aborbie, 2018). On the other hand, leaders also need to gain the employees' trust in their capabilities to successfully implement the digital transformation (Gfrerer et al., 2021). Building trust will enable employees to follow the outlined visions and changes (Wrede et al., 2020). An example of the importance of building trust is eliminating the employees' fear of changing job requirements or job loss arising from digitalization (Staffen & Schoenwald, 2016). Especially in the context of Industry 4.0, where connected machines are expected to replace human workplaces, this change process needs to be successfully bridged by the leader. One way to build a trusting environment within an organization is open and transparent communication to remove fear and uncertainty of upcoming changes (Foerster-Metz et al., 2018; Vrana & Singh, 2021). A relevant aspect of the external dimension is the transparent communication regarding customers' safety and information about possible risks of provided products and services (Lin et al., 2020)

In addition to the leadership styles mentioned above and leader's attitudes, our literature research identifies the importance of leaders to excel at soft skills in the digital age to complement the required leadership themes discussed in previous chapters (Babin & Grant, 2019; Jakubik & Berazhny, 2017; Kane et al., 2016; Kwiotkowska et al., 2021). These soft skills most frequently mentioned in our identified articles are authenticity (Hesse, 2018; Philip, 2021), empathy (Babin & Grant, 2019; Matsunaga, 2021; Mdluli & Makhupe, 2017; Philip & Gavrilova Aguilar, 2021), being humble (Kazim, 2019; Neubauer et al., 2017), emotional intelligence (Alade & Windapo, 2019; Chuang & Graham, 2020; Cresnar & Nedelko, 2020; Foerster-Metz et al., 2018; Philip, 2021; Schmidt, 2019; Sow & Aborbie, 2018), humility (Bolden & O'Regan, 2016; Neubauer et al., 2017), and resilience (Bennis, 2013; Meier et al., 2017; Schwarzmüller et al., 2018; Singh & Hess, 2017). Two aspects we want to outline explicitly are motivation and inspiration. To achieve visionary, empowerment, or risk-taking attributes, leaders must motivate and inspire their teams to follow the outlined objectives (Larjovuori et al., 2018).

In conclusion, we want to emphasize that the attributes outlined in the category "humility, social & soft skills" can be a prerequisite to enable the leadership aspects we have discussed earlier. Therefore, those should support leadership success in digitalization within this theme and enable or support other themes.

Cultural awareness & diversity

The last key theme for digitalization leadership skills is cultural awareness and diversity. Digitalization leads to the formation of virtual teams with globally dispersed teams (Schwarzmüller et al., 2018). Therefore, leaders must embrace and support multicultural teams' collaboration (Cresnar & Nedelko, 2020; Mdluli & Makhupe, 2017) and possess intercultural competencies (Eberl & Drews, 2021; Rüth & Netzer, 2020). Another challenge for leaders guiding digital transformation processes is coping with the multigenerational workforce and their different experiences with digital technologies (Chuang & Graham, 2020; Cresnar & Nedelko, 2020; Herold, 2016; Kazim, 2019; Mdluli & Makhupe, 2017). Especially for mature workers who did not grow up with digital technologies compared to younger generations, digital leaders can provide specific training to bridge a potential knowledge gap and create an inclusive digital working environment (Chuang & Graham, 2020). Besides awareness of

Fig. 2. Search terms employed to gather initial search results.

diversity and inclusion, leaders should be ethically responsible (Cresnar & Nedelko, 2020; Herold, 2016). We summarized our identified nine themes in Fig. 4.

Conclusion

The digital transformation of companies poses a complex challenge which leaders must actively guide to succeed within a fast-paced and constantly changing environment. Digitalization entails numerous different aspects and perspectives to be considered. The first step for successful leadership is acknowledging the existence of different digitalization dimensions. Based on this knowledge, leadership can be tailored more specifically towards the currently relevant aspect of digitalization, whether focusing on the external or the internal dimension.

The classification of the 92 relevant articles for digitalization and leadership indicatedthat most of the current literature focuses on the overall organization rather than specific internal or external aspects of the company. On the one hand, we confirm the gaining interest in the research stream of digitalization and leadership in general. On the other hand, a further specialization, which further breaks down different digitalization activities, offers an opportunity to provide more specific insights into required leadership skills. As we could not identify any existing research that connects leadership and digital servitization, distinct problem statements from either scientific or business perspectives require further consideration In summary, we have not identified any significant differences in digitalization's internal or external leadership but can conclude that the outlined characteristics are generally valid for both sides. Nevertheless, we added specific examples that might support leaders practically within specific internal or external digitalization efforts.

However, the nine identified themes span different areas from the leader's mindset, skillset, organizational setup, or personal characteristics, thus probably requiring a distinctive approach to learning, applying, and mastering them. By being aware of our outlined themes and specific internal and external aspects, leaders have a roadmap to orient their own development as well as the development of their organization. The themes should not be seen as isolated items but can be intertwined and support each other. Therefore, indirectly applying one aspect can positively contribute to working on another characteristic. Our identified themes do not interfere with each other. Thus, implementing one area should not hinder working on a different dimension.

Limitations and further research implications

By its nature, even an exhaustive literature review is limited to reproducing and organizing existing knowledge in published articles. We could add further scientific value by conducting empirical research on the most relevant topics. Further efforts could be made by conducting metanalyses analyzing the effects and specific relevance of identified works or themes on

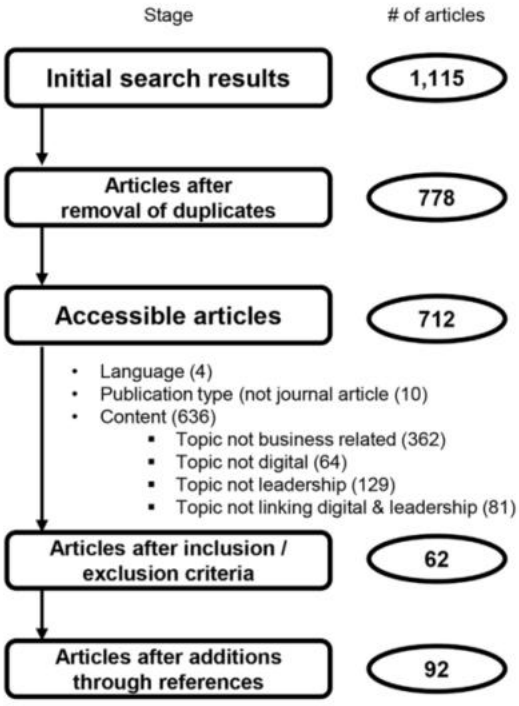

Fig. 3. Results of the literature review process.

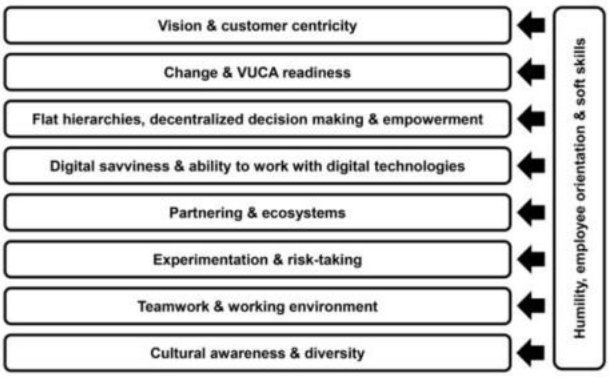

Fig. 4. Nine themes for leadership of internal and external digitalization.

digitalization leadership. This would then help to weigh or rank the importance of research and indirectly of our outlined nine themes.

There is, of course, always a possibility that our identified search terms were not all-encompassing, especially due to the restriction to articles that were published in English or German. One way to deal with this general problem was by reviewing the complete bibliographies of the found articles to add additional literature. This routine at least minimizes the risk of missing relevant articles. The initially applied classification of our search terms within the theory section into internal and external digitalization (see Fig. 2) was not directly used to cluster the quantitative results displayed in Table 1. Applying the classification from the search term without properly reviewing our identified articles would have led to incorrect classifications per our set definitions. Nevertheless, our original clustering can still be seen as valid as it relates to our theoretical understanding of the terms.

A finding of our literature review's quantitative analysis results is that we have not identified any existing research working on combining digital servitization and leadership. However, as we recognized the increasing importance of digital servitization, we propose further research about the leadership requirements for successfully implementing digital servitization. Another result of the quantitative display of articles clustered by target areas showed that current research mainly focuses on digital leadership aspects that focus on the entire organization. We identified the internal perspective mainly represented by articles for leadership on Industry 4.0 implementations. Articles for the external perspective are underrepresented, so we would also conclude that this is an opportunity for future research on how leadership can contribute to a digital product, service, business model development, and customer relationships.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Digital servitization and leadership: A holistic view on required leadership traits and skills

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Abstract

PURPOSE: *Digitalization and servitization are two major developments significantly disrupting companies' competitive landscape. The research area that combines both aspects, digital servitization, poses substantial opportunities and challenges for companies to navigate. It requires guidance from leadership to succeed and innovate, but current scientific research lacks a holistic view on leadership for digital servitization so far.* ***METHODOLOGY:*** *We conducted 30 semi-structured interviews with leaders active in digital servitization initiatives, holding positions ranging from first-level managers to vice presidents and executives. Eighteen have more than ten years of leadership experience. Through inductive coding, we derived 43 codes within a qualitative analysis. We applied thematic analysis to structure our findings, resulting in a thematic map of leadership skills for digital servitization based on the research participants' insights.* ***FINDINGS:*** *Our findings present a holistic view of leadership skills for digital servitization. Leaders need to consider the perspectives of strategic business and people leadership. Digital servitization requires leaders to engage in a wide range of activities. From a strategic business leadership perspective, this ranges from evolving goal setting, a comprehensive business understanding, the ability to find the right team composition, and understanding customer and market needs. The people leadership perspective requires leaders to create and communicate a vision for digital servitization and manage change and employees' fears while enabling and empowering employees. Furthermore, we identified that digital servitization requires a balanced level of cognitive, interpersonal, business, and strategic leadership requirements.* ***IMPLICATIONS:*** *We contribute to scientific research by providing a comprehensive definition of digital servitization and summarizing existing research focusing on leadership aspects of digital servitization. Our findings offer actionable insights for practitioners by approaching with a holistic view on digital servitization and considering strategic business and people leadership aspects. Applying our outlined themes will support leaders in improving the conditions and possibilities to successfully trigger and implement digital servitization activities within their companies.* ***ORIGINALITY AND VALUE:*** *Our research combines isolated leadership aspects for digital servitization and underlines the complexity of digital servitization, emphasizing the need for a holistic view. Outlining the element of balancing business and people skills provides novel insights on advancing digital servitization into the research domain, which is dominated by technical-oriented research.*

Keywords: *digital servitization, leadership, servitization, digitalization, change management, innovation, digital transformation, business, strategy*

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INTRODUCTION

Globalization and complex business environments are altering the business landscape for manufacturing companies (Kim & Toya, 2018). Within the last decade, transformational challenges such as globalization, demographic changes, or digitalization (Pęciak, 2016) have changed existing business models, customer relationships, and how products are developed, manufactured, and delivered (Frank et al., 2019). Manufacturing companies pursue differentiation by adding customer-oriented services to their existing offerings (Chen et al., 2021). Vandermerwe and Rada (1988) first described the phenomenon of adding value to the core offerings through services. They coined servitization as offering bundles of customer-focused combinations of goods, services, support self-service, and knowledge. Servitization can be seen as a strategic alternative to product innovation (Carlborg et al., 2014) and enhances customer relationships through customized and integrated offerings (Coreynen et al., 2017; Paschou et al., 2020). In addition to increasing service offerings, companies in almost all industries have conducted several initiatives to explore new digital technologies and exploit their benefits (Matt et al., 2015). Digitalization is described as using digital technologies (Fitzgerald et al., 2014) such as the Internet of Things (IoT), cloud and mobile services, artificial intelligence, big data, and social media (Mihardjo et al., 2019) to change existing processes, business models, and revenue streams. (Bloomberg, 2022; Clerck, 2017).

Despite originating from different research fields, scholars see a supporting link between servitization and digital technologies (Paschou et al., 2020; Vendrell-Herrero et al., 2017). The convergence of servitization and digitalization is called digital servitization and refers to developing new services or improving existing ones through digital technologies to enable new (digital) business models. (Gebauer et al., 2021; Paschou et al., 2019, 2020; Vendrell-Herrero et al., 2017). Large manufacturing companies such as General Electric or Rolls-Royce have introduced service business models enabled by digital technologies (Paschou et al., 2020). For example, whereas the aviation engine producer Rolls Royce implemented IoT technologies that allow monitoring engine data in real-time for compelling maintenance offerings, General Electric has developed analytic tools to enable remote monitoring services based on data analysis of the installed base (Evans & Annunziata, 2012; Lightfoot et al., 2013).

Nevertheless, scholars describe that most companies lag behind their expectations around digital servitization (Pham & Vu, 2022), mainly caused by complexity and interplay of involved stakeholders, making digital servitization challenging to manage (Kohtamäki et al., 2021). Utilizing digital technologies in servitization is associated with innovation (Coreynen et al., 2017). Especially when it comes to radical innovations and their realization, leadership is required and described as one of the most influential factors for innovation (Faix, 2020; Rosing et al., 2011). Reconfiguring business models, such as implementing digital services, requires organizational change (Bustinza et al., 2018), which Kotter (2000) defined as a leadership responsibility. Leadership requires a diverse set of skills ranging from cognitive, interpersonal, business, and strategic skills (Mumford et al., 2007), which extant literature emphasizes as important for building a true service culture (Dmitrijeva et al., 2020).

Digital servitization is a relatively new research stream (Paschou et al., 2020), mainly focusing on qualitative and case study-based research on how companies can supplement their service offerings through digital technologies (Gebauer et al., 2021). Some researchers point out certain aspects attributable to leadership concerning digital servitization. For example, Cimini et al. (2021) elaborated on employee competence development within digital servitization through case-study research. Another research contribution by Kohtamäki et al. (2021) provided insights into business skills for digital servitization through a single case study. Sklyar et al. (2019) investigated the scientific research on organizing activities for digital servitization, thus focusing on more strategic leadership aspects.

Despite its widely recognized importance for innovation and growth and rising research interest in digital servitization (Favoretto et al., 2022), current scientific research lacks a holistic view of leadership aspects and managerial decision-making models (Paschou et al., 2020). In the context of this study, a holistic view of leadership is understood as considering the multi-faceted aspects of leadership, such as cognitive, interpersonal, business, or strategic skills requirements (Mumford et al., 2007) and the different scopes of applicability ranging from leading individuals and teams (Day et al., 2004), building business models (Doz & Kosonen, 2010), financial and technology understanding to visioning and communication skills (Men et al., 2020).

The present, qualitative study aims to contribute through an exploratory research design, providing insights into relevant leadership skills for digital servitization through the following research questions: What are the relevant leadership skills for digital servitization? What is the scope of the leadership role, and what are the affected leadership skill requirements for digital servitization?

Using the data from thirty semi-structured interviews with leaders active in digital servitization activities, we examined which focus areas within companies and interpersonal relationships form a holistic view to support managing the inherent complexity of digital servitization.

LITERATURE REVIEW

The convergence of digitalization and increased service focus by building digitally enabled service business models are coined digital servitization (Paschou et al., 2019; Vendrell-Herrero et al., 2017). We first deconstruct the theoretical backgrounds of servitization and digitalization to introduce the current scientific discussion on digital servitization and highlight the connection to innovation. The following sections introduce the topic of leadership with a specific emphasis on the digital age before summarizing the current research contributions linking digital servitization and leadership.

Servitization, digitalization, and digital servitization

The term *servitization* was first introduced by Vandermerwe and Rada (1988) to increase value by adding services to a company's offering. Manufacturing companies transform from product-centric to service-oriented business models (Frank et al., 2019; Kowalkowski et al., 2017; Raddats et al., 2019). The change in business model expects a fuller market offering through the customer-oriented combination of goods, services, support, self-service, and knowledge (Vandermerwe & Rada, 1988). Baines et al. (2020) categorized services into base, intermediate, and advanced services (see also Figure 1). Whereas base services are related to warranties and spare parts, intermediate services can be understood as maintenance and repairs. Advanced services are more complex value propositions where companies provide performance outcomes such as pay-per-use contracts (Baines et al., 2020; Martinez et al., 2017).

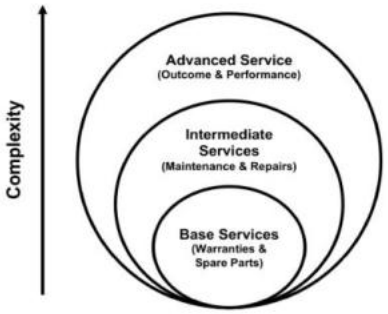

Figure 1. Service levels
Source: Own illustration based on Baines et al. (2020).

Servitization strategies can bring advantages compared to single product offerings. From a commercial perspective, adding service offerings leads to more steady revenue streams and higher profit margins (Baines et al., 2007; Bustinza et al., 2013; Gebauer et al., 2005; Wise & Baumgartner, 1999). Companies are more resistant to economic cycles than product-only businesses, especially in heavy investment industries (Oliva & Kallenberg, 2003). Servitization additionally creates the opportunity to achieve competitive advantages by addressing unmet customer needs (Oliva & Kallenberg, 2003). Manufacturing companies can offer customized and tailored service offerings to their customers, which are more difficult to imitate (Baines et al., 2007, 2009; Gebauer et al., 2005; Oliva & Kallenberg, 2003). Thus, manufacturing companies can avoid price-based competition (Baines et al., 2007). The servitization process describes a business model change from transactional to relationship-oriented interaction with customers (Oliva & Kallenberg, 2003) and increases customer loyalty by locking in customers, locking out the competition, and creating dependency for sustained business relationships (Bustinza et al., 2013; Vandermerwe & Rada, 1988).

Digitalization and the emergence of digital technologies offer new potential to facilitate service innovation of manufacturing companies (Ardolino et al., 2018; Coreynen et al., 2017). Technology development enables the incorporating

of digital technologies into previously purely physical products (Hirsch-Kreinsen, 2016; Yoo et al., 2012). Digital technologies such as the Internet of Things, cloud and mobile services, artificial intelligence, big data, analytics, social media, and embedded devices are the foundation for companies' digitalization (Fitzgerald et al., 2014; Mihardjo et al., 2019; Vial, 2019).

A research stream that recently emerged is digital servitization. Several authors have published a definition of digital servitization. Vendrell-Herrero et al. (2017) described digital servitization as providing IT- or digitally enabled services that rely on digital components embedded in physical products. Another definition provided by Tronvoll et al. (2020) emphasized deploying digital technologies to support the transformation from a product-centric to a service-centric business model. Kohtamäki et al. (2019, p.4) presented a more technical-oriented definition as a "transition toward smart product-service-software systems that enable value creation and capture through monitoring, control, optimization, and autonomous function." Paschou et al. (2019) offered a very encompassing definition. They referred to digital servitization as developing new services or improving existing ones using digital technologies by enabling new digital business models, finding ways of co-creating value, generating knowledge from data, improving a firm's operational performance, and gaining competitive advantage. Despite defining the same term, we conclude that existing research has a different emphasis and focus areas when describing digital servitization. Whereas Vendrell-Herrero et al. (2017) relied on the connection to the physical product, Paschou et al. (2019) did not mention products in their definition when describing digital servitization. All definitions quoted above share that they see digital technologies as a core element of moving towards digital servitization. In addition, the aspects of value creation and business model changes are mentioned in all definitions except the one from Vendrell-Herrero et al. (2017).

Besides existing definitions of other researchers, we outline specific attributes of digital servitization to describe our understanding of the paper's central term (see Figure 2). Digital technologies enable several services and business models, such as remotely tracking and reporting real-time information, monitoring customers' usage behavior, responsive and proactive maintenance, remote control of operations, and availability services (Paiola & Gebauer, 2020). These digital services depend on data availability and analytics (Tronvoll et al., 2020; Ulaga & Reinartz, 2011). Manufacturing companies and product firms possess an existing customer base called an installed base. Access to this installed base based on previous product deliveries and the ability to harness and leverage customers' data is the basis for successful digital servitization (Paiola & Gebauer, 2020). Compared to a product-centric business relationship, where the product is the basis for the business relationship, the product only becomes one element of the interaction in a more service-centric business model (Paiola & Gebauer, 2020). Companies' customer relationship shifts from a transactional to a relational view (Ehret & Wirtz, 2017). Thus, digital servitization is underpinned by changing the business model and value creation processes (Chen et al., 2021). Companies help customers reach their goals by providing digitally enabled services (Coreynen et al., 2017). Based on the aspects mentioned above, we define digital servitization as generating additional value for the installed base of existing customers by providing product and service bundles enabled by digital technologies through newly created or revised business models. Our definition highlights the interplay of products and services, as both components are required to create value for the companies' customers. These services can only be assigned to customers where the manufacturing company sells a product-service bundle at the time of the transaction or previously supplied a product, which now enables the provision of digital services. Thus, the installed base is a core element of our definition as it initially defines the accessible market for digital servitization activities. Digital technologies enable new or revised business models due to the ability to access and connect information and data, which manufacturing companies use to create revenue streams.

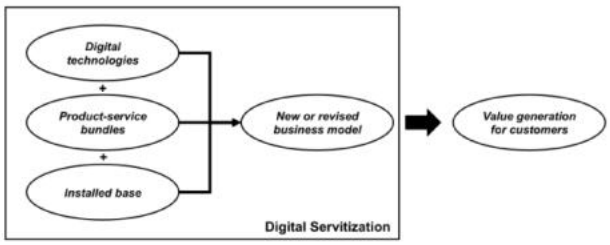

Figure 2. Definition of Digital Servitization

For manufacturing firms, servitization and digitalization are complex transformations requiring organizational changes. Thus, digital servitization requires new resources, capabilities, and collaborations to support value generation (Lerch & Gotsch, 2015; Peillon & Dubruc, 2019). Scholars proposed changes in the organizational structure to meet evolving customers within digital servitization (Baines et al., 2017; Bustinza et al., 2018). In the following section, we outline the impact of leadership on organizational changes and how to capture innovative business models within the context of digital servitization.

Leadership for digital servitization

Leadership is crucial for enabling innovations, shifting business models, and guiding organizational change (Faix, 2020; Mihardjo et al., 2019; Nadler & Tushman, 1990). Leadership has been widely researched (Kotterman, 2006), but focus areas and applications have developed over time due to changing boundary conditions and transformations in business and society (Larjovuori et al., 2018). Faix et al. (2020, p. 61) described leadership as "to lead oneself and human communities […] into an innovative and creative future in open and complex situations under unclearly defined and dynamic conditions while always considering the framework conditions and collective rationality." In his understanding of leadership, Kotter (2000) also highlighted producing change, setting direction, and aligning people toward a visionary goal.

Based on a concept developed by Mumford et al. (2007), leadership skill requirements can be categorized into cognitive, interpersonal, business, and strategic skills. Cognitive Mumford et al., (2007), skills are seen as foundational for leaders (Mumford et al., 2007), including communication skills (Yukl, 1989), learning (Jacobs & Jaques, 1987), adapting to deal with non-routine and dynamic job components (Kanungo & Misra, 1992), and critical thinking (Gillen & Carroll, 1985). Interpersonal leadership skills are associated with social skills such as interaction, influencing (Katz, 1974), or persuading others (Yukl, 1989), focusing on people orientation. The area of business skills can be associated with managerial leadership tasks such as management of resources (e.g., material, personnel, or financial) (Katz, 1974), also including functional expertise and technical know-how (Mumford et al., 2007). The final category, strategic skills, requires conceptual thinking in complex systems from leaders (Mumford et al., 2007; Zaccaro, 2001). The associated skillset includes topics such as visioning (Conger & Kanungo, 1987), problem-solving (Cox & Cooper, 1988), or decision-making (Mumford et al., 2007) abilities.

A research area that recently gained attention is "digital leadership." It describes the elements of strategic success of digitalization for enterprises and their business ecosystems (de Araujo et al., 2021; El Sawy et al., 2016). Authors highlighted specific leadership attributes positively influencing digitalization. For example, leaders in a digital world should have a clear vision of transforming their company and acting as active drivers for innovation (Kane et al., 2019; Westerman et al., 2014). Given the fast-paced VUCA (volatility, uncertainty, complexity, ambiguity) environment, existing research on digital leadership described the attributes of fast decision-making (Larjovuori et al., 2018; Neubauer et al., 2017), embracing change (Kane et al., 2019) and open-mindedness to new ideas (Guzmán et al., 2020; Imran et al., 2021) as required responses to digital changes. In line with the speed of the market environments, risk-taking (Kane et al., 2015) and creating environments for experimentation (de Araujo et al., 2021) were seen as supportive of creating digital innovations. Another significant aspect outlined by leadership research for digitalization is collaborating within ecosystems and engaging in partnerships. Companies benefit from networks with suppliers, customers, and other stakeholders such as universities or start-ups (de Araujo et al., 2021; Ivančić et al., 2019). Collaboration beyond organizational limits supports companies' ability to keep up with new developments and innovate in the digital age (Gurumurthy & Schatsky, 2019; Larjovuori et al., 2018). A holistic view covering the multi-faced leadership skill requirements in the digital context are for example, provided by Eberl & Drews (2021), Guzmán et al. (2020), Imran et al. (2020) or Tagscherer & Carbon (2023).

As indicated earlier, previous research on digital servitization emphasized certain aspects of leadership skills and activities. Struyf et al. (2021) summarized specific topics such as strategic development, organizational development, networking, and organizational decision-making in their research on a multilevel perspective on digital servitization. Kim and Toya (2018) researched the leadership style for servitization within Japanese manufacturing companies, not considering the digital context. Their empirical results indicated charismatic and transformational leadership styles supporting servitization efforts. On the other hand, autocratic and autonomous leadership styles impede successful servitization (Kim & Toya, 2018). Furthermore, we structured the extant contributions of digital servitization research and the associated leadership aspects in Table 1.

Table 1. The main outcome from the literature review on digital servitization and leadership

Reference	Research focus	Contribution
Kim & Toya (2018)	Leadership styles for servitization	Charismatic leadership style is supportive for organizational change required for servitization Required top-management efforts to inspire commitment from employees
Cimini et al. (2021)	Competence development for digital servitization	Agile and collaborative mindset is essential for digital servitization Training provisions for soft skills and digital literacy are important Competence development for sales and marketing employees involved in digital service offerings
Struyf et al. (2021)	Multilevel framework for digital servitization	Digital servitization is a complex and interrelated requiring proactive management to be overcome Effective management of digital servitization challenges is an iterative process and agile approach
Tronvoll et al. (2020)	Required change initiatives for digital servitization	Focusing on customer value Defining and maintaining a vision for digital servitization Cultivating agile ways of working Shorter timelines for target-setting
Sklyar et al. (2019)	Organizing for digital servitization	Setting out a comprehensive vision for digital servitization Close collaboration between service and product organizations

Source: Kim and Toya (2018); Cimini et al. (2021); Struyf et al. (2021); Tronvoll et al. (2020); Sklyar et al. (2019).

The identified studies elaborating on leadership aspects for digital servitization recognized the complexity of shifting towards digital servitization (Struyf et al., 2021). Common recommendations include the creation of a vision (Sklyar et al., 2019; Tronvoll et al., 2020) and applying agile ways of working (Cimini et al., 2021; Struyf et al., 2021; Tronvoll et al., 2020) asking for close internal and external collaboration for digital servitization (Cimini et al., 2021; Sklyar et al., 2019). Furthermore, extant literature highlights the requirement for top management involvement and commitment towards digital servitization (Kim & Toya, 2018; Struyf et al., 2021).

METHODOLOGY

Our research aims to gain exploratory insights into the research question of a holistic view on leadership skills for digital servitization due to its underexplored nature. The extant literature on digital servitization and leadership has been reviewed to build a theoretical background for formulating the distinct questions of the semi-structured interview guide. We selected the method of semi-structured interviews as a well-proven and fitting instrument for qualitative and exploratory research (Kallio et al., 2016). We generally used open-ended questions to support the exploratory nature of the research (Weller et al., 2018). Before inquiring about our main research question of required leadership skills for digital servitization, we ensured generating a common understanding for the two main subjects of the study: digital servitization and leadership. Furthermore, we added subsequent questions regarding change management, risk attitude, goal-setting process, role in ecosystems, and communication skills, which were identified as essential leadership aspects in our previous literature review on leadership, digital leadership, and the five articles referenced in our literature review on leadership for digital servitization. The interview guide with the respective questions is presented in Appendix 2. The applied research procedure is based on a combination of the works of Braun and Clarke (2006), Mayring (2014), and Thomas (2006) on qualitative research analysis and depicted in Figure 3 with a particular emphasis on the step of data analysis.

For the data collection, we used purposive sampling: We contacted potential research participants through the business network platform "LinkedIn" based on matching job titles to ensure their expertise in providing insights into our research question. This included the search terms "digital services," "servitization," "digitalization," and "digital transformation." Besides an initial check about the suitability of our research participants through conversation, we validated their contribution through their job titles, position in the company hierarchy, industry association of their company, and years of leadership experience. Our research participants held positions at different firm levels, ranging from first-level managers to Directors, Vice Presidents, and Executives. On the one hand, this spread allows insights from various perspectives based on hierarchy levels within the company but also allows strategic leadership relevance due to the significant number of senior-level leaders in our reference group.

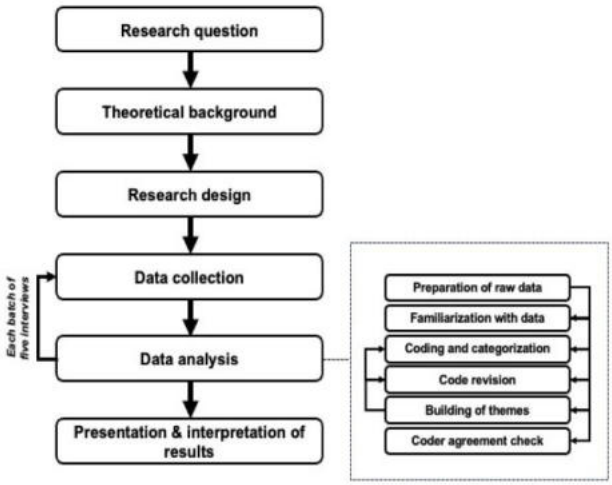

Figure 3. Research procedure

Source: Own illustration based on Braun and Clarke (2006,) Mayring (2014), and Thomas (2006).

Furthermore, we used the Global Industry Classification Standard (GICS) to present the industry in which the companies of our research participants were active (MSCI, 2022). Besides the leaders in the business or IT consulting, classified as professional services or IT services according to GICS, our research participants were also employed in companies active in the machinery or electrical equipment industry. As those industries are mainly concerned with manufacturing and servicing equipment, we can confirm their relevance for our study on digital servitization. Lastly, we present the years of leadership experience in defined categories. Similar to the spread at the company level, the range of leadership experience offers insights into different perspectives based on experience. Table 2 shows the distribution of leadership experience ranging from up to five years of leadership experience to very experienced leaders with more than twenty years in active leadership roles.

Table 2. Research participants

Identification of research participants by search terms	Amount	Share in %
Digital services	9	30%
Servitization	9	30%
Digitalization	5	17%
Digital Transformation	7	23%
Total	*30*	*100%*
Company level	Amount	Share in %
Executive	6	20%
Vice President	5	17%
Director	6	20%
Head of	7	23%
Manager	6	20%
Total	*30*	*100%*
Industry	Amount	Share in %
Professional Services	5	17%
Machinery	15	50%
Automobiles & Components	1	3%
Chemicals	2	7%
Electrical Equipment	3	10%
IT Services	4	13%
Total	*30*	*100%*

Leadership experience	Amount	Share in %
0-5 years	6	20%
6-10 years	6	20%
10-20 years	10	33%
>20 years	8	27%
Total	*30*	*100%*

One researcher conducted and recorded the interviews online via Microsoft Teams to ensure consistency from April 2023 to July 2023. We decided to include a loop between data collection and data analysis after each batch of five interviews to assess code saturation (Hennink et al., 2017), which was reached after thirty interviews. For the first step of the data analysis, we used the 2023 version of Microsoft Teams' system-immanent transcription function as an initial baseline and manually optimized the raw data through intelligent verbatim transcription while rehearing the interviews. This step ensured the correctness of the research participants' statements and improved readability, which formed the baseline for analyzing the interview transcripts (McMullin, 2023). After familiarizing with the data, we used the software MAXQDA (VERBI Software, 2021) for the code development. We followed Braun and Clarke's (2006) thematic analysis to identify codes and themes using an inductive approach following our exploratory research design. Nevertheless, we would like to acknowledge that parts of the codes are theory-driven (Braun & Clarke, 2006). They are based on the outcome of the previously conducted review about the theoretical background to formulate our interview questions. Thus, our study includes elements of deduction due to our research design (Mayring, 2014; Thomas, 2006), which are further refined by inductive elements based on the nuanced statements of the research participants (Fossey et al., 2002). Within a recursive process, we conducted our coding, which required refinements and optimization of the code structure (Braun & Clarke, 2006; Mayring, 2014). Additionally, we collated codes into perspectives, themes, and sub-themes to structure our findings based on their relations and connections. Within this step, initial codes were summarized, rephrased, or discarded to create a thematic map within a three-stage model to present the results (Braun & Clarke, 2006). The coding process is depicted in Appendix 1. One researcher performed the initial coding based on the outlined procedure. Researcher bias and the reliability quality criteria were addressed through an inter-coder check of the research partner, who served as a supervisor with access to all material, definitions, and codings (Mayring, 2014). The review did not result in disagreement with our coding results, thus supporting the conclusions on the basis of our findings and, thus, increasing cross-reliability.

We reviewed our transcripts inductively to set up the initial code set referring to our research question of leadership skills and traits for digital servitization. Afterward, we structured our initial code set of 43 items into sub-themes, themes, and perspectives through an iterative process. Twelve of our initial codes were not included in the thematic map while reviewing our themes. There was insufficient data to support them, or they were disqualified during the refinement process (Braun & Clarke, 2006). The exclusion criteria "insufficient supporting data", "mentioning specific communicational channels", and "no actional item for leaders" are assigned explicitly for each initial code in Appendix 1. In addition, we rephrased two of our initial codes after the initial coding procedure to better represent its content. Furthermore, we summarized the remaining 31 codes into 20 sub-themes, further clustered into five themes. During this process, we eliminated the initial "internal change management" code and labeled one "change management" theme to represent the associated content. Lastly, our presentation of the thematic map of leadership aspects for digital servitization was finalized by identifying two main perspectives (see also Table 3). The process of coding the interviews and reviewing the identified themes led us to structure our findings in a three-level setup. Furthermore, interview statements were included for further explanation and detailing based on research participants' quotations. The far-right column of the thematic map (Table 3) explains the themes' coding origin, whether they are inductive and emergent findings or entail a degree of deductive and theory-driven origin due to applied theoretical background to formulate the interview guide's research questions. Furthermore, we have included the sources for the theory-driven codes.

RESULTS

On the highest level of the thematic map, we present two perspectives – strategic business leadership and people leadership. Moreover, both perspectives entail further themes to specify the different aspects of required leadership skills for digital servitization. From the strategic business leadership perspective, this entails "strategic business decisions," "business building elements," and "market and customer." On the people leadership side, we summarized the sub-themes into the

themes of "change management" and "employee orientation" themes. Table 3 outlines all 19 sub-themes categorized into the five themes, including exemplary interlocutors statements and the explanation of the coding origin.

Table 3. Thematic map leadership for digital servitization

Perspectives	Themes	Sub-themes	Interview statements	Coding origin
Strategic business leadership	Strategic business decisions	Conscious top management decision for digital servitization	• "We would always say that servitization is a C-level conversation first and foremost" • "Do you really want to do that as a company?" • When an organization and the leadership decides to build a business case in the area of digital servitization"	Inductive and emergent finding
		Evolving target setting within digital servitization journey	• "Every time you have two or three other metrics that are really defining your success" • "Don't do only financial targets, do some other measurable targets" • " […] it really depends where you are in your journey in digitalization. So if you are at the beginning, […] I would put very different targets."	Inductive findings but the degree of deduction and theory-driven codes due to interview question on goal-setting process derived from, e.g.: Tronvoll et al. (2020)
		Positive financial contribution	• "I think in the end, every business in the medium and long term must earn money" • "The end goal is to make money or to have a business that is sustainable"	Inductive and emergent finding
		Risk-taking and risk management	• "You have to manage the risks" • "I'm more used to actually take bigger risks, but controlled ones" • "You need to be open for an open failure culture as well"	Inductive findings but degree of deduction and theory-driven codes due to interview question on attitude towards risk derived from e.g.: Kane et al. (2015)
	Business building elements	Comprehensive business understanding	• "Obviously they need to understand technology and the business and strategy perspective" • "that means as a leader you have to have a complete oversight of the business" • "It is the strategy, the business case, the monetization"	Inductive and emergent finding
		Agile methods	• "You need to be very agile" • "I think here agile methods are a good thing in this field".	Inductive and emergent finding
		Cross-functional collaboration	• "You need to unite the different people. So from finance to HR to operations to all of the different teams and personas which you need to bring together." • "You need to really think beyond your department or your group" • "From the leadership perspective it's much more about collaboration and interorganizational collaboration"	Inductive and emergent finding
		Team composition	• "You need to have the right people in your team which are eager to create something new" • "I hate to say it, there is a pretty decent change you are going to have some attrition"	Inductive and emergent finding
		External collaboration	• "Partnering is extremely important because you have to be really aware all the time what kind of possibilities you have […] and that technology is changing so rapidly" • "When it's about developing some new thing you need also to get some outside impulses" • "Because the market is changing so fast, you need to have different partners for different things"	Inductive findings but the degree of deduction and theory-driven codes due to interview question on ecosystems and partnerships derived from e.g: Gurumurthy & Schatsky (2019); Larjovuori et al. (2018)
	Market and customer	Understand customer and market needs	• "You have to put yourself into the customers' shoes and being customer-centric" • "We have to collaborate closer with the customer already in the beginning and don't be afraid of talking about something that is not yet finished" • Be aligned with market needs because many organizations that do a lot of product development at the end, they come to the conclusion that the market doesn't need that"	Inductive and emergent finding
		Focus on value creation for customers	• "The value proposition should be very clear to the customer that what value they will get" • "Focus on the value" • "Speak about the value for the customers"	Inductive and emergent finding

Perspectives	Themes	Sub-themes	Interview statements	Coding origin
People leadership	Change management	Vision creation for digital servitization	• "They have to provide a vision to the employees" • "Leadership certainly demands an ability to create a vision and convey the vision" • "Create a joint vision" • "I would go back to the vision. That's one of the main drivers for that change management" • "You need to give them a vision. You need to give them a direction without setting too hard borders"	Inductive and emergent finding
		Communication of the vision understandably and regularly	• ""It must be easy to communicate and easy to understand" • "Speaking the language of the people you want to convince" • "Communication on a very frequent level" • "I wouldn't go too much in the technical terms"	Inductive findings but degree of deduction and theory-driven codes due to interview question on communication derived from e.g.: Mumford et al. (2007); Yukl (1989)
		Creation of a sense of urgency and why the change is required	• Build a sense of urgency around it, but also understand if we're not able to adapt at some point we're going to be in trouble" • "I think they should clearly explain why business model change is needed and why it's on the immediate horizon"	Inductive findings but degree of deduction and theory-driven codes due to interview question on enabling change derived from e.g.: Bustinza et al. (2018); Kane et al. (2019)
		Awareness of employees' fears	• "Take away that fear to the employees" • "I would want to address that fear or that anxiety" • "The fear of people, especially people above fifty"	Inductive and emergent finding
		Speed & patience	• "Things can move very quickly, so you have to be in a position to react quickly to that" • Especially in a subject like digital servitization, which is very fast" • "Digital servitization is nothing that you can do in three months. So that's a very long journey"	Inductive and emergent finding
	Employee orientation	Employee participation and feedback	• "You need to be able to go down into the trenches with the people and […] and one of the traits is be really open to feedback' • "I think giving feedback is really important"	Inductive and emergent finding
		Enablement & empowerment	• "To empower each and everyone to take her or his role and driving it jointly" • "But not control them in their jobs, but rather enable them in their jobs" • "Because you shoudn't do everything on your own, but you have to enable the people"	Inductive and emergent finding
		Training and skill development	• "It should go down to the point of whereby the leader has educated or trained the sales and service people who are actually on the customer front" • "So it's not only communicating, it's also training the sales force, the marketing, etc."	Inductive and emergent finding

Strategic business leadership perspective

Strategic business decisions

The first leadership decision is required by the firm's top management whether to pursue digital servitization activities. Based on this, leaders in charge of the needed undertakings should be assigned. Those individuals require full backing from the executive level in terms of financial and personal resources. One research participant stated: "It is a C-level conversation because of the substantially huge degrees of change" (Interview #24). On the contrary, top management must clearly state if they do not see digital servitization as the current focus topic to avoid a waste of resources if projects are pursued without aligned consent from the executive level. The following statements of the research participants support this: "Do you really want to do that as a company? […] I think leadership means that the company and the leaders provide a clear direction (Interview #8)." Another participant added: "You have to have the openness and I would call it the real commitment that you want to do that (Interview #12)."

From a goal-setting perspective, the research participants emphasized the importance of targets, KPIs (key performance indicators), and performance measurements to succeed within digital servitization. As digital servitization is a new approach to the business for most incumbent companies, the success of the new business model should not solely be measured by financial attributes such as order intake, sales, or profit as one research participant highlighted: "Don't do only financial targets, do some other measurable targets (Interview #2)." Instead, more qualitative and customer-oriented targets, for

example, "I think other KPIs besides the pure money like customer satisfaction, customer loyalty, these are the important things (Interview #22)", should be focused on, especially in the beginning, on measuring building the business model.

Another comment recommended, "I think in the beginning it's much more relevant that you think about the customer backward in terms of customer experience, customer satisfaction, added value for customers. Because whenever you enter something new, I think these are the key elements, and they should be first (Interview #8)."

Based on the statements, we recommend an evolving approach, depending on the maturity level of the digital servitization topics. An executive's point of view underlines this: "At the beginning, you're managing are we learning? Then, are we innovating? Then, are we finding the our first business? Are we scaling? (Interview #16)" In addition, those KPIs and targets should be short-term and change along the development of the business model, emphasized by one research participant: "If you are at the beginning of the journey, I would put […] very short terms like quarterly targets (Interview #30)." The more digital servitization becomes a regular part of the traditional business, the more traditional goal setting can be applied to link business success to financial performance indicators.

Despite prioritizing non-financial measurements at the beginning of digital servitization activities, leaders shall emphasize the ultimate reasoning of business activities – profit contribution and positive cash flow. A research participant's statement underlines this as follows: "It must be a business model which flies, which means that you earn money (Interview #22)" and "to be really sure that you are able to make money with the business model (Interview #18)". Therefore, reaching a self-sustaining business model through digital servitization needs to be considered. Even though digital servitization is a new topic for the company, it shall not be excluded from basic economic principles, which is emphasized through the comments: "The end goal is to make money or to have a business that is sustainable (Interview #15)," or "I think in the end, every business in the medium and long term must earn money (Interview #22)."

Linked to the previous subject, pursuing digital servitization requires a certain amount of risk-taking, which we explicitly inquired about in our interview questions. One leader described a difference between investments in machinery and manufacturing lines and digital servitization: "The only thing that is different if we talk about digital is that the first step is cheaper. […] You can test much more in the early steps that you could do with other investments (Interview #15)." Nevertheless, we found consent when analyzing the interview sessions that active risk management is required for digital servitization, underlined with the following statements:

"You always have to manage the risk (Interview #9)." "You need to understand what is happening, and be able to manage [the risk] all the time (Interview #13)." "You have to make the risk manageable and make it transparent to do that (Interview #7)."

On the one hand, this means establishing mechanisms to identify and understand risks and their potential outcome. On the other hand, continuous control and mitigation of those risks are required to ensure the activities do not harm the overall business or customer relations. In addition, leaders must be aware that fast failure and a trial-and-error mentality are supportive in an uncertain digital environment, which our research participants stated as follows: "acceptance of failure (Interview #2)", "you need to be open for an open failure culture (Interview #7)", or "with digital you really have to accept that you will make errors simply because you cannot foresee everything (Interview #6)."

Business building elements

The second theme in the business perspective is "business building elements". Here, we summarize all relevant elements our research participants answered for building a successful digital servitization business model, including organizational setups or leadership focus areas.

Besides a basic understanding of the underlying technology, our research participants highlighted the need for a comprehensive business understanding. For example, "they need to understand technology, the business, and the strategy perspective (Interview #22)". One Director emphasized: "You have to understand the business that you're standing up (Interview #20)", which is supported by another statement: "As a leader, you have to have complete oversight of the business system (Interview #18)." This also includes the resulting impacts on accounting models, business processes, or sales approaches, which are crucial to understand and consider while steering digital servitization activities. Especially the aspect of monetization was mentioned during the interviews: "Sometimes also monetization models look very different than in a one-time payment world (Interview #22)." A Director added:

"How am I going to handle this asset, or are we going to own the asset? Are we going to sell this asset to a third party if I offer a service model? […]. So the leadership has to be holistic because you are literally standing up a new business (Interview #20)."

To develop and refine digital servitization business models, our research participants suggested applying agile methods such as SCRUM to ensure fast development and the ability to adapt quickly in case of changing settings in the surrounding areas. Especially in digital servitization, leaders can use those concepts to react to changing technology trends or shifting customer requirements. Agile aligns with the above-mentioned trial-and-error mentality due to the short-paced iterations within the sprints. The research participants' statements underlined this: "You need to be very agile (Interview #6)", "the agile way of defining leadership (Interview #9)," or "I think here agile methods are a good thing in this field (Interview #27)."

Another crucial leadership skill for digital servitization within the theme of business-building elements relates to cross-functional collaboration. This also links to the previously mentioned comprehensive business understanding, which emphasizes the holistic view of different aspects within the firm. This is typically structured within various departments with specialized domain know-how within companies. Focusing on including and fostering the collaboration and exchange between those different areas is beneficial during digital servitization activities. A Director highlighted: "There has to be a tremendous amount of collaboration between sales, marketing, finance, accounting, field operations, et cetera (Interview #20).". Therefore, "a collaborative culture where people actually desire to collaborate with all of these cross-functional teams (Interview #20)." Building a solid network within the company is imperative to gain access and ensure excellent cross-functional collaboration with the necessary individuals from the traditional departmental structures. Therefore, digital servitization leaders are often required to lead their teams without formal reporting lines and directional power.

"[Leaders] need to unite the different people, from finance to human resources to operations to all of the different teams and personas you need to bring together on this joint journey (Interview #22)."

Besides cross-functional collaboration, certain aspects of composing teams can be outlined. Especially at the early stages, our research participants recommended selecting team members interested in the topic as they declared it is self-motivating for these individuals. The research participants highlighted the importance of having the right people: "I think you need to have the right people in your team who are eager to create something new (Interview #26)." Nevertheless, leaders should consider balancing their teams with a good mix of experience, business knowledge, or educational background. This allows for diverse discussions to enable the potential best outcome of the exploratory phase of digital servitization. When the topic is scaling up within the company, it requires caution not to let unmotivated or unqualified managers or employees slow down or block this expansion due to wanting to stick to the historical or traditional way of doing their job.

"You are going to have x percent […], they just want to do things the way they've been doing it for the past 35 years. […] they could actually be contra to your desires (Interview #20)."

For those situations, leaders' bold action and moving those employees to other areas where they can contribute more or even terminate them not to harm the overall business development are proposed leadership activities as one research participant foresaw attrition as a required element in the team composition. This is underlined: "Who will not fit in some of these roles? I hate to say it, but there's a pretty chance you're going to have some attrition (Interview #20)."

Lastly, leaders responsible for digital servitization should consider developments outside the companies' boundaries and actively pursue external collaboration. Especially in the digital context of digital servitization, our research participants strongly suggested partnering with other actors such as start-ups or academia. One research participant stated: "If there are start-ups which have strong knowledge about a certain technology which you believe is relevant for you, you should certainly talk to them and set up partnerships (Interview #26)." Due to the rapid developments of technology, support is essential to gain access and speed in applying the know-how of external partners to advance companies' business models. This is emphasized by:

"Because the market is changing so fast, that you need to maybe have different partners for different things (Interview #30)" and "partnering is extremely important because […] the world and the technology is changing so rapidly. So if you try to do this alone without a good network, it is impossible (Interview #13)."

Several research participants concluded that pursuing their developments with internal resources would consume too many resources and drastically slow down the digital servitization journey, risking not keeping up with the market or competitors' pace. For example, this is underlined by "it is completely outdated to do everything on your own (Interview #25)" and "I think companies need to quit thinking only they can master a specific task (Interview #26)." By outlining internal and external collaboration, we underline the requirement for focusing on "when it's about developing some new things, you also need to get some outside impulses (Interview #11)."

Market and customer

Leaders associated with digital servitization business models should focus on the sales side in addition to the internal and organizational aspects. With the theme of market and customer, we conclude the strategic business leadership perspective by summarizing the responses covering these essential areas.

Our research participants emphasized the requirement to understand the needs of customers. Terms like "customer-centricity" or "put yourself in the customers' shoes" were highlighted to understand customers' needs. Understanding customers' problems and challenges is vital to tailoring the digital servitization offerings to address these. Therefore, close customer engagement and obtaining feedback on customer requirements were suggested. "We have to collaborate closer with the customer already in the beginning and don't be afraid of something that is not yet finished already or market ready (Interview #27)." On the contrary, developing a digital servitization business model that does not fulfill market needs can be avoided by this deep market understanding. One research participant brought up:

"Be aligned with market needs because many organizations that do a lot of product development, but in the end, they come to the conclusion that the market doesn't need that (Interview #11)."

Digital servitization offerings can often be new to customers from either the digital technology side or the aspect of offering new business models from the servitization point of view. Therefore, we summarize that leaders should keep the value creation for customers in mind when creating and marketing digital servitization offerings, which are underlined by a "focus on the value (Interview #27)." To enable customers to pay a recurring fee for the offerings, they need to be convinced of how these offerings generate value for them. Therefore, "[…] the value proposition should be very clear to the customer and what value they will get (Interview #4)." This aspect was mentioned in the context of customer interaction and communication "to speak about the value for customers (Interview #27)."

People leadership perspective

Besides the strategic business leadership perspective, our research participants highlighted the importance of people orientation of leaders for digital servitization. In the following, we outline the aspects assigned to the themes of change management and employee orientation.

Change management

As described in the previous strategic business leadership section, digital servitization changes and differentiates from the existing business models – "it's a huge change within your company (Interview #25)".

Additionally, it affects almost all employees, spanning practically all company departments. In addition to working with new digital technologies, the organization is also asked to change its way of working through the increased service orientation and the related business model alternations. Due to those circumstances, one research participant declared:

"[…] change management, in my opinion, is by far and above the single biggest barrier that digital leaders have, then it comes to trying to convince the rest of the organization (Interview #1)."

Therefore, in the following, we highlight the most frequently used recommendations leaders can apply to guide their organization and motivate the employees to follow the digital servitization journey. The first sub-theme relates to creating a compelling vision for digital servitization, which was described as "one of the main drivers for that change management because you need to be able to imagine […] but even more visualize the vision (Interview #3)." This vision builds the foundation on where the company wants to go with digital servitization and how it fits within its overall strategy and "[needs to be provided] to the employees and [the leaders] need to make clear that the vision is also shared by the employees, that they understand where they are going (Interview #25)." It is described as "some kind of understood picture of how this all could work in the future (Interview #15)." A strong vision was mentioned as a critical factor for leaders to guide and motivate their employees, which is recommended that "leadership demands an ability to create a vision and convey […] the vision (Interview #24)." One manager said "You need to give them a vision without setting too hard borders (Interview #3)." Additionally, our research participants recommended involving employees to create a "joint vision (Interview #22)" to increase the commitment to follow this vision in digital servitization change management.

Once created, the next crucial leadership task is to communicate the vision. Based on the expert opinions we obtained, we outline several success factors for this step. The vision should be translated and made understandable for all affected individuals within the company. This is underlined: "I think in the end, it must be easy to communicate and easy to

understand (Interview #22)." Or "speaking the language of the people you want to convince (Interview #15)." On the one hand, this means explaining the technological changes comprehensively and refraining from technological buzzwords but emphasizing digital servitization's business model impacts and benefits. One Head of emphasized: "I wouldn't go too much in technical terms (Interview #15)." On the other hand, translating what the activities accompanying digital servitization change in the daily work lives of individuals within the company.

"People have to understand it, and the next step is that people have to understand what their own role is in this idea and what they have to contribute (Interview #12)."

Therefore, the impacts should be explained continuously to ensure they reach and convince their employees. This active communication helps generate a positive message and support throughout the organization for the change required for digital servitization. Lastly, our research participants emphasized the need for continuous, regular, and consistent communication to highlight the importance of the necessary change. Therefore, "communication on a very frequent level (Interview #28)," "there should be continuous communication (Interview #4)," and "sometimes you have to repeat it (Interview #25)" describe statements from the interviews.

The topic of highlighting the "why" and creating a sense of urgency for the change related to digital servitization was underlined during the interviews. Especially when companies still experience positive results through their traditional business "because a lot of the traditional manufacturing companies don't feel the pressure yet (Interview #29)", it is required that leaders explain why digital servitization activities should be pursued. As part of the change communication, highlighting the sense of urgency supports convincing employees to follow the new business model opportunity. Therefore, "you need to […] create a sense of urgency. Why do you need to change? (Interview #26)". Without initiating the change process, the company will miss out on future business potential through digital servitization offerings because "you need to build a sense of urgency around it, but also understand if we're not able to adapt to that we're going to be in trouble (Interview #16)." Leaders "should clearly explain why business model change is both needed and why it's on the immediate horizon (Interview #1)."

The introduction of digital servitization business models can significantly alter existing workplaces. It could make some obsolete and create new job profiles based on different skill set requirements. These changes can develop fears for employees holding these affected roles of losing their jobs or being unable to fulfill the upcoming requirements. One research participant described this: "I'm even scared that this is taking my job away because I don't have the education for that area (Interview #30)." Our research participants also highlighted a difference in openness for digital servitization due to generational differences, "especially people above fifty (Interview #5)." Leaders must know these fears to understand potential resistance to support the required change process as one leader described: "There was a lot of resistance inside this organization because they always thought […] I might lose my job (Interview #29)." Therefore, providing options for affected employees by either finding a new role within the company or upskilling them for the new requirements is an associated leadership task by explaining "We need you in a different position (Interview #10)." If appropriately accompanied, removing the fear from employees arising from emerging technologies or new business models is a vital success factor for the change management to pursue digital servitization successfully.

The final relevant item of the change management theme relates to the time perspective. In line with the fast-paced changes in digital technology, "trial and error"-mentality, agile methods, and required external collaborations for speed, our research participants emphasized the need for quickness within digital servitization: "Things can move very quickly, so you have to be in a position to react quickly to that (Interview #1)." Additionally, "in a subject like digital servitization, which is, I think, very fast, changing with a lot of new technologies coming (Interview #2)." Nevertheless, the overall change process of implementing digital servitization requires patience and time. One Head of emphasized: "Digital servitization is nothing that you can do in three months. So that's a very long journey (Interview #12)." Notably, aligned with the sub-theme "positive financial contribution", one of our research participants recommended, "be somewhat patient with time but be very, very impatient with the results (Interview #1)."

Employee orientation

The final theme of employee orientation focuses on the leaders' required soft skills for digital servitization, whereby its sub-themes complement the previously mentioned items due to their overarching nature.

Enabling their employees to actively participate and ask for continuous feedback during the digital servitization journey is crucial for leaders. This mindset supports several of the leadership themes. For example, our research participants recommended allowing employees to participate in the vision creation process to increase commitment. Secondly, leaders

should consider gaining feedback from employees close to the customers regarding market developments and value creation needs for digital servitization solutions. A Head of pointed out: "Feedback is also very important because sometimes what we are offering, maybe they don't need those things (Interview #4)." Another point described the closeness: "You need to be able to go down into the trenches with the people (Interview #29)." Leaders can, for example, use this continuous feedback in agile development cycles for business model development. Also, employees' feedback should be actively heard and incorporated during the change process to avoid losing employee connection. A research participant's statement underlined this: "I couldn't agree more that the change management is the most crucial, but you need to involve the people (Interview #3)." Additionally, our digital servitization leaders emphasized the benefit of a mutual goal-setting process, which results in ambitious but realistic targets.

Within the set boundaries of the vision, strategy, and goals, freedom should be granted to employees. This includes enabling them to make decisions independently and structure projects within the set guard rails aligned with the leadership.

"Not to control them in their jobs, but rather enable them in their jobs (Interview #24)."

Due to the recommended application of agile methods and the trial and error mentality, enablement and empowerment benefit faster development times without constant alignment. Another aspect is the increased motivation by granting room for entrepreneurship and less micro-management. "[Leaders] shouldn't do everything on [their] own, but enable the people (Interview #27)" and "empower each and everyone to take her or his role and drive it jointly (Interview #22)."

As the final sub-theme, our research participants recommended focusing on training and skill development as supporting elements for success in digital servitization. It requires general training to apply digital technologies, whereas increased knowledge supports the change process by reducing employees' fears. "It's not only communication; it's also training the sales force, marketing, et cetera (Interview #14)." Critical is the education of the sales teams responsible for selling digital servitization offerings, which was described as follows: "It should go down to the point where the leader has educated or trained the sales and service people who are actually on the customer front line (Interview #1)." Besides understanding the underlying technology, customers should be convinced of the additional value creation through these new offerings. Additionally, sales education should incorporate the shift from asset to service selling, as "this will be something completely new in most cases (Interview #26)."

DISCUSSION

Our identified leadership skills address the complexity of digital servitization (Kohtamäki et al., 2021; Struyf et al., 2021) through the multitude and diversity of identified themes and sub-themes. The decision to pursue digital servitization activities has wide-ranging impacts on companies. Digital servitization influences existing organizations from several perspectives. Therefore, digital servitization requires a multi-faceted leadership approach. Although previous research focused on specific leadership elements, our research provides structured guidance and a holistic view of leadership skills for digital servitization. However, specific themes have also been also identified in extant literature. For example, Kim and Toya (2018) highlighted the need for top management involvement in successful servitization implementation in Japanese manufacturing firms. However, their research did not focus on the digital component, which we confirmed in our study. The topic of target setting has also been given attention in the research of Tronvoll et al. (2020), which recommended short cycles for target adjustments, similar to those proposed by our research participants. However, our findings contribute by adding qualitative content to the target-setting for digital servitization. Especially the insights of evolving targets and including customer-oriented measurements within the digital servitization journey add value to the scientific discussion. Whereas the theme of applying agile methods was already outlined in scientific research on digital servitization (Cimini et al., 2021; Struyf et al., 2021), the statements of our research participants about the need to focus on positive financial contribution and the leadership requirement of a comprehensive business understanding has not been explicitly mentioned. Notably, the need for a comprehensive business understanding ranging from technology, finance, or IT underlines the complexity of managing digital servitization activities described by Kohtamäki et al. (2021) and Struyf et al. (2021). The focus on customers and the value creation through digital servitization, which our research participants highlighted through statements such as "focus on the value" or "it's important to speak about the value (Interview #27)", is similarly presented by Tronvoll et al. (2020) as an essential success factor. Within the perspective of people leadership, we explicitly present change management and employee orientation as the central themes relevant to leading digital servitization. Although the connection between change and digital servitization is recognized in extant literature (Kohtamäki et al., 2021; Sklyar et al., 2019; Tóth et al., 2022; Tronvoll et al., 2020), the presentation of our

research results provides a deeper understanding of required leadership activities. Ranging from "creating a joint vision (Interview #22)", "you need to have a clear vision (Interview #3)," and "speaking about the vision in a way people can relate to (Interview #5)", to "build[ing] a sense of urgency around it (Interview #16)", our research participants pointed out the required need for awareness of employees' fears and to "address the fear or that anxiety (Interview #5)." Lastly, the theme of employee orientation relates to the call of Cimini et al. (2021) for soft skill development and competence training for sales employees in digital servitization. However, the aspects related to employee participation, enablement, and empowerment provide further support for other leadership skills due to their overarching nature.

Leadership skills can be associated with strategic, business skills, interpersonal, or cognitive skills, overall supported by universal cognitive skills. Consequently, we underline the importance of applying a holistic view of leadership to address hurdles in establishing digital servitization (Figure 4).

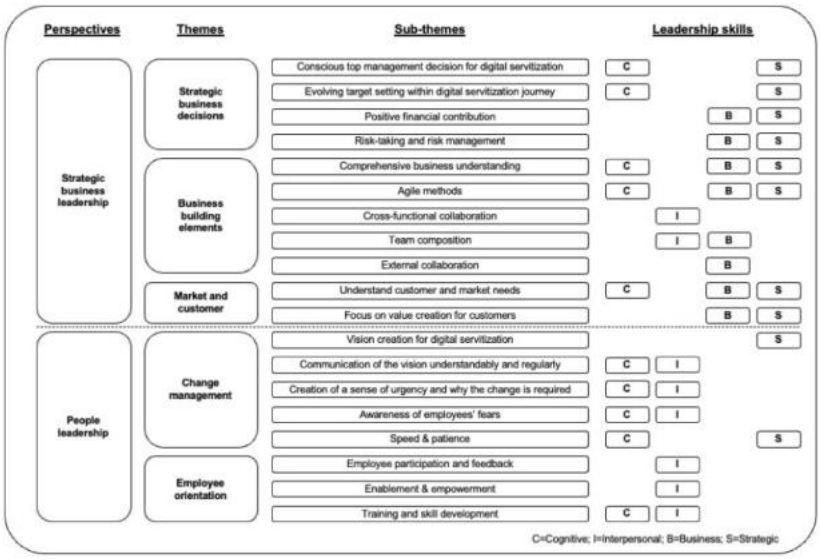

Figure 4. A holistic view on leadership for digital servitization

Source: Own illustration based on findings: association of leadership skills based on Mumford et al. (2007).

Based on mapping our thematic map to the four leadership skills described by Mumford et al. (2007), we see a balance between cognitive, interpersonal, business, and strategic skills among our 19 sub-themes. Cognitive skills as a foundational layer (Mumford et al., 2007) are identified as critical for leading digital servitization. This can be explained by their supportive nature, including understanding, comprehending, and communicating, which is required for strategic business and people leadership. On the other hand, we see tendencies of allocation of interpersonal, business, and strategic leadership skills to our identified leadership themes. Whereas the strategic business leadership perspective requires efforts in business and strategic skills, the people leadership perspective is reflected in cognitive and interpersonal leadership skills. The combination of the diverse skill requirements within digital servitization of applying strategic decision-making but also being close to employees is a significant ask to leadership. Furthermore, we point out that leadership for digital servitization involves several, sometimes opposite, touchpoints. For example, leaders active in digital servitization need to collaborate "typically [with] a lot of players (Interview #24)" inside and outside their company. Moreover, they interact with stakeholders such as customers, suppliers, and employees. As companies have the conception of falling behind their progress expectations on digital servitization (Pham & Vu, 2022), we offer support with our holistic view on the role and tasks of leaders to avoid missing out on understanding the diverse outlined leadership themes of strategic business leadership and people leadership or the lack of understanding of the lengthy duration as "it takes time (Interview #23)." Additionally, digital servitization interferes with several actors. On the one hand, digital servitization requires cross-

functional collaboration of several departments and "unit[ing] the different people (Interview #22)." On the other hand, companies are interacting with customers, suppliers, or other ecosystem stakeholders. Thus, our findings that digital servitization affects several departments require change management, and a long implementation period contributes to the research from Sklyar et al. (2019) on how to organize digital servitization with specific leadership aspects. In summary, our research questions are answered by displaying our thematic map of a holistic view on leadership for digital servitization by pointing out specific elements within the expressed sub-themes. The required scope of leadership is presented by diverse perspectives describing the need to focus on strategic business and people leadership, which are further detailed by the presented themes: strategic business decision, business building, market and customer, change management, and employee orientation. Lastly, mapping the required leadership skills to cognitive, interpersonal, business, and strategic skills describes the leadership skill requirements, which underline the holistic view on leadership for digital servitization.

CONCLUSION

Our findings outline essential decisions along the digital servitization journey, starting from the very first decision on whether those business models should be pursued at all. The identified leadership themes also give insights into the required considerations, skills, and traits for leaders to moderate the change process and motivate and educate their employees to implement digital servitization business opportunities successfully. Failure to build successful digital servitization business models can result in multiple adverse outcomes, such as lost financial funds or misallocated personal resources. Even more critical could be the loss of differentiation criteria against competitors or failure to fulfill potential customer needs. Furthermore, employees could feel misguided and lose faith in their leadership. Our research work supports reducing the risks above by raising awareness of the different aspects and multitude of activities, ultimately contributing to growth and profit expectations from digital servitization.

We contribute to scientific research and the practical digital servitization community. Firstly, we define digital servitization as "generating additional value for the installed base of existing customers by providing product and service bundles enabled by digital technologies through newly created or revised business models," which is customer-oriented and value-based. Furthermore, we conducted a qualitative study combining the aspects of digital servitization and leadership, acknowledging the diverse set of skills ranging from the strategic, business, or personal side, which has lacked scientific attention so far. Furthermore, mapping the identified leadership skills with cognitive, interpersonal, business, and strategic leadership requirements exemplifies the need for diverse competencies to manage complex digital servitization activities. The resulting leadership themes provide guidance to practitioners on what to consider leading for digital servitization and which leadership skills are required for which aspect of digital servitization. Our contribution of pointing out the holistic view on leadership can support digital servitization leaders as guidance within the daily practice to avoid missing out or neglecting vital leadership themes due to insufficient knowledge or resource allocation. Furthermore, executives can apply our research findings to staff their leadership teams assigned for digital servitization diversly to balance out different leadership personalities with the requested skillset. Without either of our outlined perspectives, strategic business leadership and people leadership can significantly harm companies' advancements in digital servitization. On the one hand, a strategic decision-making process neglecting customer or market needs or lacking a comprehensive business understanding could steer companies in the wrong direction. On the other hand, missing out on the people's perspective and neglecting the importance of change management harms employee motivation and, thus, companies' performance within digital servitization.

As we based our findings on a holistic view on leadership for digital servitization (Table 3) based on qualitative interviews and inductive analysis of the responses, we acknowledge the limitations of this research approach. Despite the significance of 30 research participants, it simultaneously corresponds to the limitation of the research material. Nevertheless, the variation of job titles, hierarchical levels, and industries of our research participants offers a broad range of viewpoints. Our identified themes representing a holistic view on leadership are set up based on a well-proven scientific method through gathering qualitative interview statements and our approach structuring them through inductive coding. Nevertheless, we recognize additional research potential to solidify our findings further.

Firstly, we recommend testing and confirming our leadership themes through quantitative research. On the one hand, this method can be used to statistically confirm the initially created theme structure through an increased number of responses. Furthermore, a quantitative research method with the presented leadership aspects as a baseline can create a ranking or weighing of the identified sub-themes to provide further insights into the identified items' prioritization,

importance, or impact. Another proposal for continuing research builds on a more long-term oriented case-study research design, where researchers accompany leaders applying the leadership skills for digital servitization in their practical business environment. While closely surveying the usefulness of our proposed themes and sub-themes, this research approach can give detailed insights into the applicability and effectiveness of our research results. Additionally, this could be compared to leaders and firms who follow our recommendations for a holistic view on leadership versus others who do not and pursue digital servitization activities without this guidance.

Our final further research recommendation links to the multitude and diversity of identified leadership themes for digital servitization. As leaders inherit different personality types or practice certain leadership styles, we propose further research to map digital servitization to the fit of specific personality types or leadership styles. This aspect can give more precise guidance for leadership on appointing to lead digital servitization within companies.

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Appendix

Appendix 1. Coding system and building of thematic map

1) Initial coding result		
Initial code	**Coding origin**	**Action**
Conscious top management decision for digital servitization	Inductive and emergent	
No quarter-to-quarter	Degree of deduction and theory-driven due to interview question on goal-setting process. Derived from, e.g.: Tronvoll et al. (2020)	Summarized to „Evolving target setting within digital servitization journey"
Customer-oriented KPIs	Degree of deduction and theory-driven due to interview question on goal-setting process. Derived from, e.g.: Tronvoll et al. (2020)	
From quality to financial targets	Degree of deduction and theory-driven due to interview question on goal-setting process. Derived from, e.g.: Tronvoll et al. (2020)	
Positive financial contribution	Inductive and emergent	
Trial & Error		Summarized to risk-taking and risk management
Digital is rather cheap at the beginning		
Risk Management & Risk Calculation	Degree of deduction and theory-driven due to interview question on attitude towards risk. Derived from, e.g.: Kane et al. (2015)	
Cross-functional collaboration	Inductive and emergent	
Comprehensive business understanding	Inductive and emergent	
Agile methods	Inductive and emergent	
Have the right people	Inductive and emergent	Rephrased to „Team composition"
So fast or new you need external help	Degree of deduction and theory-driven due to interview question on ecosystems and partnerships. Derived from, e.g.: Gurumurthy & Schatsky (2019); Larjovuori et al. (2018)	Rephrased to „External collaboration"
Understand customer and market needs	Inductive and emergent	
Focus on value creation for customers	Inductive and emergent	
Vision creation for digital servitization	Inductive and emergent	
Creation of a sense of urgency and why the change is needed	Degree of deduction and theory-driven due to interview question on enabling change. Derived from, e.g.: Bustinza et al. (2018); Kane et al. (2019)	
Internal Change Management	Degree of deduction and theory-driven due to interview question on enabling change. Derived from, e.g.: Bustinza et al. (2018); Kane et al. (2019)	
Continuous & regular communication	Degree of deduction and theory-driven due to interview question on communication. Derived from, e.g.: Mumford et al. (2007); Yukl (1989)	Summarized to „Communication of the vision understandably and regularly"
Communicate understandably	Degree of deduction and theory-driven due to interview question on communication. Derived from, e.g.: Mumford et al. (2007); Yukl (1989)	
Not too technical communication	Degree of deduction and theory-driven due to interview question on communication. Derived from, e.g.: Mumford et al. (2007); Yukl (1989)	
Generational differences	Inductive and emergent	Summarized to „Awareness of employees' fears"
Employees fears	Inductive and emergent	
Job changes	Inductive and emergent	
Fast & flexible	Inductive and emergent	Summarized to „Speed & patience"
Patience / it takes time	Inductive and emergent	
Feedback	Inductive and emergent	Summarized to „Employee participation and feedback"
Participation & Involvement	Inductive and emergent	
Leader not as expert	Inductive and emergent	Summarized to „Enablement & empowerment"
Enablement & empowerment	Inductive and emergent	
Training and skill development	Degree of deduction and theory-driven due to interview question on communication. Derived from e.g.: Mumford et al. (2007); Yukl (1989)	

Digital channels	Degree of deduction and theory-driven due to interview question on communication. Derived from, e.g.: Mumford et al. (2007); Yukl (1989)	no further consideration due to: - linsufficient supporting data (Data security, convince customers, change from engineering mindset, change of traditional after market mindset, convince traditional business leaders, balance existing and new business, bring in external people) - mentioning of specific communication channels (Digital channels, face to face, trade shows) - no actionable item for leaders (Topic itself is motivating, trust)
Face to face	Degree of deduction and theory-driven due to interview question on communication. Derived from, e.g.: Mumford et al. (2007); Yukl (1989)	
Trade shows	Inductive and emergent	
Data security	Inductive and emergent	
Convince customers	Inductive and emergent	
Change from engineering mindset	Inductive and emergent	
Change of traditional after market mindset	Inductive and emergent	
Convince traditional business leaders	Inductive and emergent	
Balance existing and new business	Inductive and emergent	
Bring in external people	Inductive and emergent	
Topic itself is motivating	Degree of deduction and theory-driven due to interview question on communication. Derived from, e.g.: Mumford et al. (2007); Yukl (1989)	
Trust	Degree of deduction and theory-driven due to interview question on communication. Derived from, e.g.: Mumford et al. (2007); Yukl (1989)	

2) Building of sub-themes

Sub-theme	Initial code	Action
Conscious top management decision for digital servitization	Conscious top management decision for digital servitization	Grouped into „Strategic business decisions"
Evolving target setting within digital servitization journey	No quarter-to-quarter	
	Customer-oriented KPIs	
	From quality to financial targets	
Positive financial contribution	Positive financial contribution	
Risk-taking and risk management	Trial & Error	
	Digital is rather cheap at the beginning	
	Risk Management & Risk Calculation	
Cross-functional collaboration	Cross-functional collaboration	Grouped into „Business building elements"
Comprehensive business understanding	Comprehensive business understanding	
Agile methods	Agile methods	
Team composition	Have the right people	
External collaboration	So fast or new you need external help	
Understand customer and market needs	Understand customer and market needs	Grouped into „Market and customer"
Focus on value creation for customers	Focus on value creation for customers	
Vision creation for digital servitization	Vision creation for digital servitization	Grouped into „Change management"
Creation of a sense of urgency and why the change is needed	Creation of a sense of urgency and why the change is needed	
Internal Change Management	Internal Change Management (Eliminated as summarized in theme „change management")	
Communication of the vision understandably and regularly	Continuous & regular communication	
	Communicate understandably	
	Not too technical communication	
Awareness of employees' fears	Generational differences	
	Employees' fears	
	Job changes	
Speed & patience	Fast & flexible	
	Patience / it takes time	
Employee participation and feedback	Feedback	Grouped into „Employee orientation"
	Participation & Involvement	
Enablement & empowerment	Leader not as expert	
	Enablement & empowerment	
Training and skill development	Training and skill development	

3) Summarizing to themes

Themes	Sub-theme	Initial Code	Action

Strategic business decisions	Conscious top management decision for digital servitization	Conscious top management decision for digital servitization	Clustered into „Strategic business leadership"
	Evolving target setting within digital servitization journey	No quarter to quarter	
		Customer-oriented KPIs	
		From quality to financial targets	
	Positive financial contribution	Positive financial contribution	
	Risk-taking and risk management	Trial & Error	
		Digital is rather cheap at the beginning	
		Risk Management & Risk Calculation	
Business building elements	Cross-functional collaboration	Cross-functional collaboration	
	Comprehensive business understanding	Comprehensive business understanding	
	Agile methods	Agile methods	
	Team composition	Have the right people	
	External collaboration	So fast or new you need external help	
Market and customer	Understand customer and market needs	Understand customer and market needs	
	Focus on value creation for customers	Focus on value creation for customers	
Change management	Vision creation for digital servitization	Vision creation for digital servitization	Clustered into „People leadership"
	Creation of a sense of urgency and why the change is needed	Creation of a sense of urgency and why the change is needed	
	Communication of the vision understandably and regularly	Continuous & regular communication	
		Communicate understandably	
		Not too technical communication	
	Awareness of employees' fears	Generational differences	
		Employees' fears	
		Job changes	
	Speed & patience	Fast & flexible	
		Patience / it takes time	
Employee orientation	Employee participation and feedback	Feedback	
		Participation & Involvement	
	Enablement & empowerment	Leader not as expert	
		Enablement & empowerment	
	Training and skill development	Training and skill development	

4) Building of perspectives → Thematic Map

Perspective	Theme	Sub-theme	Initial code
Strategic business leadership	Strategic business decisions	Conscious top management decision for digital servitization	Conscious top management decision for digital servitization
		Evolving target setting within digital servitization journey	No quarter-to-quarter
			Customer-oriented KPIs
			From quality to financial targets
		Positive financial contribution	Positive financial contribution
		Risk-taking and risk management	Trial & Error
			Digital is rather cheap at the beginning
			Risk Management & Risk Calculation
	Business building elements	Cross-functional collaboration	Cross-functional collaboration
		Comprehensive business understanding	Comprehensive business understanding
		Agile methods	Agile methods
		Team composition	Have the right people
		External collaboration	So fast or new you need external help
	Market and customer	Understand customer and market needs	Understand customer and market needs
		Focus on value creation for customers	Focus on value creation for customers

People leadership	Change management	Vision creation for digital servitization	Vision creation for digital servitization
		Creation of a sense of urgency and why the change is needed	Creation of a sense of urgency and why the change is needed
		Communication of the vision understandably and regularly	Continuous & regular communication
			Communicate understandably
			Not too technical communication
		Awareness of employees' fears	Generational differences
			Employees' fears
			Job changes
		Speed & patience	Fast & flexible
			Patience / it takes time
	Employee orientation	Employee participation and feedback	Feedback
			Participation & Involvement
		Enablement & empowerment	Leader not as expert
			Enablement & empowerment
		Training and skill development	Training and skill development

Appendix 2. Interview guide and interview questions

Research on Digital Servitization and Leadership

Interview on digital servitization and leadership

- Thank you very much for taking the time for this interview.
- Your expertise and experience are highly appreciated for gaining valuable research insights.
- Within the research, we are elaborating on the required leadership skills for digital servitization
- The research is conducted by me, xxx xxx, and supervised through xxx xxx (University of xxx)
- The interview is targeted for 45 to 60 minutes.
- Your contributions will be treated anonymously, and your responses will not be linked to your name or company/association in publications.
- To be able to concentrate during the interview as well as simplify the analysis, I would like to record this interview. Please confirm if this is ok for you.

- Before starting the recording – are there any questions from your side?

Interview section	Subsection	Questions / Probing / Detailing
Introduction		**Name** **Age** **Company size (# of employees)** **Industry** **Product portfolio** **Position**

Research on Digital Servitization and Leadership 1

Research on Digital Servitization and Leadership

Digital Servitization & Leadership	**Digital Servitization introduction**	*Digital servitization is a sub-stream of digitalization to provide digitally enabled services for manufacturing companies.* *Definition: Generating additional value for the installed base of existing customers by providing product and service bundles enabled by digital technologies through newly created or revised business models* *Examples could be maintenance offerings based on real-time engine monitoring (Rolls Royce) or remote monitoring offerings for the installed base (GE)* **What is your understanding of digital servitization? Do you have a similar/different view on digital servitization or anything to add?**
	Digital Servitization and Leadership	**How would you describe the term "leadership" in the context of digital servitization?** **Which attributes/traits/competencies are required for leaders in digital servitization?** o What are the relevant attributes for leaders to enable change towards digital servitization? o How would you characterize leaders' attitudes towards risk for digital servitization? *(Rather risk tolerant or risk averse?)* o How can the goal-setting process for digital servitization look like? *(Vision, strategy, operationalization, targets)* o What role does the work in ecosystems and partnerships play in digital servitization? (Customers, competitors, suppliers, start-ups, universities) o How should a leader communicate for digital servitization? *(internally/externally)**
Closing	**Additional comments**	**Are there any further comments or personal experiences you would like to share with regards to digital servitization and leadership?**
	Thank you	*Thank you very much for your responses and valuable insights.* *Please read the consent form and send back a signed copy.* *Once the results are available, I will be more than happy to share them with you*

Research on Digital Servitization and Leadership *additional questions not analyzed / relevant for this study 2

Appendix 3. Interviews and research participants

Interview	Industry	Company level	Identification	Leadership experience
Interview #1	Professional Services	Executive	Digital Transformation	>20 years
Interview #2	Machinery	Vice President	Digitalization	0-5 years
Interview #3	Machinery	Manager	Digital Services	0-5 years
Interview #4	Machinery	Head of	Digital Services	10-20 years
Interview #5	Machinery	Manager	Servitization	>20 years
Interview #6	Machinery	Director	Digitalization	10-20 years
Interview #7	Machinery	Director	Digital Services	>20 years
Interview #8	Automobiiles & Components	Executive	Digitalization	10-20 years
Interview #9	Chemicals	Manager	Digitalization	6-10 years
Interview #10	Machinery	Director	Servitization	6-10 years
Interview #11	Machinery	Executive	Digitalization	10-20 years
Interview #12	Machinery	Head of	Digitalization	6-10 years
Interview #13	Machinery	Manager	Digitalization	10-20 years
Interview #14	Professional Services	Executive	Digital Services	>20 years
Interview #15	Chemicals	Head of	Digital Transformation	6-10 years
Interview #16	Professional Services	Executive	Digital Services	>20 years
Interview #17	Electrical Equipment	Head of	Digital Services	6-10 years
Interview #18	Professional Services	Executive	Digital Transformation	>20 years
Interview #19	Electrical Equipment	Director	Digitalization	0-5 years
Interview #20	IT Services	Director	Servitization	>20 years
Interview #21	Electrical Equipment	Vice President	Servitization	10-20 years
Interview #22	IT Services	Vice President	Digital Transformation	10-20 years
Interview #23	Machinery	Head of	Digital Services	10-20 years
Interview #24	Professional Services	Manager	Servitization	10-20 years
Interview #25	IT Services	Manager	Digital Services	0-5 years
Interview #26	Machinery	Director	Servitization	0-5 years
Interview #27	Machinery	Head of	Digitalization	0-5 years
Interview #28	Machinery	Vice President	Servitization	>20 years
Interview #29	IT Services	Head of	Digital Transformation	6-10 years
Interview #30	Machinery	Vice President	Digital Services	10-20 years

Biographical notes

Florian Tagscherer is a PhD Student at the University of Bamberg. He holds a Master's Degree in International Management (M.Sc.) from the School of International Business and Entrepreneurship (Steinbeis University). His research interests focus on the intersection of emerging digital technologies and their implication on leadership and organizations.

Claus-Christian Carbon is Full Professor and the Head of Department of General Psychology and Methodology at the University of Bamberg. He studied Psychology (Dipl.-Psych.), followed by Philosophy (M.A.), both at the University of Trier, Germany, and received his PhD from the Freie Universität Berlin and his "Habilitation" (venia docendi) at the University of Vienna, Austria. Currently, he leads the "Forschungsgruppe EPAEG" – an international research group devoted to enhancing the knowledge, methodology, and enthusiasm in the fields of cognitive ergonomics, psychological aesthetics, and Gestalt. Furthermore, his research interests include design, aesthetics, product innovation, innovation leadership, and processing of visual arts. Since 2023, he has been an ordinary member of the European Academy of Sciences and Arts.

Authorship contribution statement

Florian Tagscherer: Conceptualization, Sampling, Data Collection, Methodology, Formal Analysis, Project Administration, Visualization, Writing – Original Draft. **Claus-Christian Carbon**: Conceptualization, Sampling, Methodology, Formal Analysis, Project Administration, Visualization, Writing, Supervision, Review & Editing.

Conflicts of interest

The authors declare no conflict of interest.

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Full Length Article

The role of transformational leadership in navigating digital servitization

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ABSTRACT

Digital servitization converges two current innovation activities in industrial companies: shifting from product-oriented to service-oriented business models and integrating digital technologies in market offerings. Adding digitalized services offers significant growth and diversification opportunities, but companies have struggled to reap its potential. Establishing digital servitization business models is underpinned by complexity, making it difficult for companies to manage. Digital servitization is a relatively new research stream, especially needing more guidance on how companies should be led to succeed in its implementation. We addressed this research gap and conducted thirty semi-structured interviews with leaders in digital servitization holding ranks ranging from first-level Managers to Vice Presidents and Executives with more than 20 years of leadership experience active in industries such as machinery, electrical equipment, or IT services. We identified transformational leadership as vital to building digital servitization business models and navigating their inherent complexity and change management requirements. Our findings include three focus areas as recommendations for leadership: giving direction, being employee-oriented, and creating an innovative and collaborative environment. Furthermore, transactional leadership aspects should be considered for specific use cases to maintain the business model, for example, improving after a certain amount of time or managing crisis mode.

Introduction

Digitalization is a megatrend that fundamentally changes existing value chains across industries (Calderon-Monge & Ribeiro-Soriano, 2024). Digitalization in companies creates opportunities for new services, intelligent products, and business models (Kohtamäki et al., 2019; Proksch et al., 2024). Servitization is another strategy companies pursue to generate additional growth potential (Khanra et al., 2021). Servitization is an organizational change process, first introduced by Vandermerwe and Rada (1988), that generates new revenue streams and delivers value through selling integrated products and service bundles (Baines et al., 2009; Bustinza et al., 2015; Leocádio et al., 2024). The introduction of digital technologies to service-oriented business models enables connectivity, monitoring, control, optimization, and autonomy of smart product-service bundles (Chen et al., 2021), resulting in innovative business models such as predictive maintenance and remote control systems (Sklyar et al., 2019; Tronvoll et al., 2020). This combination of both growth opportunities, digitalization and servitization, is called digital servitization and represents an opportunity to increase value creation for companies through digitally enabled services and new business models (Paschou et al., 2020; Shen et al., 2023; Sjödin et al., 2023).

The reconfiguration of business models through digital servitization involves a complex organizational change process due to the required transition of resources and competencies (Bustinza et al., 2018; Raja et al., 2024). Tronvoll et al. (2020) described digital servitization as a process underpinned by transformational shifts. Leaders are essential in implementing organizational change and transforming organizations from their current to their desired future state (Nging & Yazdanifard, 2015; Potosky & Azan, 2023). Transformational leadership is a scientific research concept closely associated with change management (Eisenbach et al., 1999; Warrick, 2011), where leaders are associated as role models who lead their organizations beyond self-interest with a clear vision and a sense of purpose (Stewart, 2006). Transformational leadership positively correlates with leading companies in times of change (McCleskey, 2014).

Despite the expected positive contributions, Pham and Vu (2022) describe companies failing behind their expectations in advancing digital servitization activities, amongst others, caused by the complexity and difficulty of managing them. Even though there is a rising academic interest, digital servitization is still a relatively new research stream, lacking emphasis on decision-making models (Paschou et al., 2020) and

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guidance for managing and organizing digital servitization (Sklyar et al., 2019; Tagscherer & Carbon, 2023; Tronvoll et al., 2020). Furthermore, Cimini et al. (2021) outline the focus on technical skills development within digital servitization research, lacking focus on developing leadership competencies or soft skills. Due to the complexity and difficulty of leading digital servitization, scholars call for further research supporting managing digital servitization more effectively (Gebauer et al., 2021; Tóth et al., 2022; Tronvoll et al., 2020).

Therefore, the present study elaborates and guides how leaders should approach the complex change process of implementing digital servitization business models through transformational leadership. Furthermore, we provide insights into which aspects of transformational leadership most support digital servitization. Our research aims to expand the scholarly discussion on navigating digital servitization and guide practitioners on how leaders can succeed in strengthening innovative capabilities within their firms. To ensure an exploratory perspective into the under-researched area of digital servitization and leadership, we conducted 30 semi-structured interviews with leaders in the field of digital servitization. The results were structured based on a hybrid approach of deductive and inductive methods to allow a well-rounded view of our research question. On the one hand, using examples of transformational leadership attributes as the foundation for the deductive approach provides structure to our results. On the other hand, adding inductive analysis complements the study by additional insights not retrieved through the pre-determined deductive framework. Our research design provides insights into filling the research gap of required management models for successful implementation and change towards innovating through digital servitization.

The following article is structured by first introducing digital servitization and transformational leadership as central keywords of our research and putting them into the context of existing research. Furthermore, we reflect on existing literature focusing on leadership elements for digital servitization to further specify the existing research gap. Next, the Methods section outlines our research approach, including data collection and analysis. Subsequently, we present our results, including research participants' statements, and discuss their relevance and interconnections. The article ends with our conclusions, acknowledgments of our study's limitations, and recommendations for further research.

Theoretical background

Digital servitization

The concept of servitization was first introduced by Vandermerwe and Rada (1988). They coined the phenomenon as adding value to companies' core offerings through services. More specifically, Vandermerwe and Rada (1988) described servitization as a customer-focused combination of goods, services, support, self-service, and knowledge to offer bundles to the market to sharpen companies' competitive edge. The research area of servitization is mainly allocated within manufacturing companies, where manufacturers provide services tightly coupled to their products (Baines & Lightfoot, 2014; Zahoor et al., 2023). Practical examples of successful servitization business models can be seen in Rolls-Royce Holdings plc's introduction of guaranteed flight hours from their aero engines—"Power by the Hour" (Bıçakcıoğlu-Peynirci & Morgan, 2023; Leocádio et al., 2024) or Xerox's move from providing photocopiers to offering document management (Ahn et al., 2023; Baines et al., 2009).

While adding services to existing products, companies can gain several advantages. Compared to product-only offerings, services are more resistant to economic cycles (Oliva & Kallenberg, 2003; Vendrell-Herrero et al., 2022), supporting companies to generate more stable and recurring revenue streams (Bustinza et al., 2013; Gebauer et al., 2005; Leocádio et al., 2024). Companies achieve competitive advantages through tailoring product-service bundles and integrated solution packages (Baines et al., 2007, 2009; Tian et al., 2022), which are more difficult to imitate (Gebauer et al., 2005; Oliva & Kallenberg, 2003) and help avoid price-based competition (Baines et al., 2007; Leocádio et al., 2024). Consequently, the business relationship with customers shifts from transactional to more long-term and relationship-based customer relationships (Kramer et al., 2024; Oliva & Kallenberg, 2003), locking out the competition and binding customers to the company and its offerings (Bustinza et al., 2013; Chiu et al., 2023; Vandermerwe & Rada, 1988).

Digital as the second component of digital servitization, besides servitization, arises from developing and implementing information and communication technology (Larjovuori et al., 2018). Digitization refers to the technical process of converting analog information into digital bits that can be transferred quickly, accurately, and cheaply (Brennen & Kreiss, 2016; Paul et al., 2023). Digital technologies are now incorporated into everyday products such as TVs, watches, or cars, creating intelligent systems based on sensors, networks, and processors (Yoo et al., 2012). Digital technologies are also described with the SMACIT acronym: Social, Mobile, Analytics, Cloud, and Internet of Things (Samuelson & Stehn, 2023; Vial, 2019). When companies use digital technologies to alter their existing business processes, offer digital products, or create digital business models, scientific research introduced the term "digitalization" (Verhoef et al., 2021), which gained increased scholarly attention since 2015 (Reis et al., 2018).

Current scientific research sees a strong link between digitalization and servitization. Digital servitization converges the two concepts and enables a new dimension of sophisticated and innovative service offerings for manufacturing companies (Gebauer et al., 2021; Paschou et al., 2020; Shen et al., 2023). Several authors have published definitions of digital servitization. Kohtamäki et al. (2019, p.4) see it as "transition toward smart product-service-software systems enabling value creation and capture through monitoring, control, optimization, and autonomous function." Paschou et al. (2019) point out the development of new services or improvement of existing ones using digital technologies by enabling new digital business models, finding ways of co-creating value, and generating knowledge from data. As a result, companies gain competitive advantages through digital servitization, leading to an increase in companies' operational performance. Digital technologies are the basis for digital servitization activities such as reporting real-time information, monitoring customers' usage behavior, responsive and proactive or predictive maintenance, remote control of operations, and equipment availability services (Chávez et al., 2023; Paiola & Gebauer, 2020). Data availability and analytics are crucial for these digital services (Chávez et al., 2023; Tronvoll et al., 2020). These use the installed base of existing customers based on previously sold equipment and products to leverage digital servitization as a customer-oriented business model for companies (Paiola & Gebauer, 2020; Raja et al., 2024).

A change in a business model such as digital servitization can significantly impact companies and requires an organizational change effort to benefit from it (Bustinza et al., 2018; Kohtamäki et al., 2019; Momeni et al., 2024; Sklyar et al., 2019). The increased complexity of digital service offerings is accompanied by changes in involved stakeholders in various areas of the value chain (Marelli & Dello Sbarba, 2024). Companies must interact with hardware and software providers, might have different contacts on the customer end, and a change of departments' internal resource and responsibility allocation (Sklyar et al., 2019). Kohtamäki et al. (2019) and Dalenogare et al. (2023) call for collaboration across company boundaries within the ecosystem when implementing smart product-service bundles, as changes in one company's business model affect others due to the interconnectedness of processes, data, and information. A change in a business model must be governed and implemented by leaders within an organization (Adama & Okeke, 2024; Turyadi et al., 2023). Digital servitization is a complex change process from various perspectives. On the one hand, new digital technologies and their application is introduced. On the other hand, the shift to combined product-service offerings and the resulting change in

market approach and customer interaction are being pursued. Transformational leadership is a leadership style that scientific research associates suitable for change processes and employee commitment to organizational change (Anderson, 2017; Bagga et al., 2023; Ly, 2024; Shadraconis, 2013), which is further described in the following chapter.

Transformational leadership within the full range leadership model

Initially introduced in a political context, Burns (1978) first published ideas on the concept of transformational and transactional leadership, which was further developed by Bass (1985) for organizational research (Eisenbach et al., 1999). The Multifactor Leadership Questionnaire (MLQ), developed by Bass and Avolio (1997), is the most widely used instrument to measure transformational and transactional leadership. Based on a total of 45 questions, the questionnaire distinguishes between three leadership styles (Kirkbride, 2006; Muenjohn & Armstrong, 2008):

- Non-leadership (laissez-faire),
- Transactional leadership,
- Transformational leadership.

Laissez-faire leadership is associated with indecisiveness, uninvolvement, withdrawal, or reluctance (Bass & Avolio, 1990). Transactional leadership builds on agreement and compliance with the leader in return for rewards and recognition, implying close monitoring of deviances and mistakes, resulting in corrective action (Bass et al., 2003). Transactional leadership is achieved by management through exception and contingent reward strategies (Kirkbride, 2006). Thus, transactional leadership seeks to maximize efficiency in well-ordered societies.

Transformational leadership is seen as suitable for times of distress and change (Bass, 1985; McCleskey, 2014). Transformational leaders elevate the desires of followers for achievement and self-development, increasing followers' confidence and gradually moving them from concerns of existing to achievement, growth, and development (Bass & Avolio, 1990). Comparing the three leadership styles, laissez-faire leadership is rated as inactive (passive), transactional leadership is in the middle, and transformational leadership is the most active of the three styles. This classification is depicted in Fig. 1, which describes the Full Range Leadership Model and explains the continuum of leadership styles (Humphreys, 2001). Moreover, the model ranks efficiency among the three styles, with laissez-faire leadership as the least efficient and transformational leadership as the most efficient (Kirkbride, 2006).

Over several decades of research and revisions of the original concept, most authors in this field of research characterize transformational leadership with the four common I's—idealized influence, individualized consideration, inspirational motivation, and intellectual stimulation (Hay, 2006). Leithwood and Jantzi (2000) proposed six transformational leadership characteristics—building vision and goals, providing intellectual stimulation, offering individualized support, symbolizing professional practices and values, demonstrating high-performance expectations, and developing structures to foster participation in decisions. We see similarities in both categorizations but continue to use the common four I's as the central concept for future discussions due to its empirical validation in several research works.

More specifically focused on the four common I's of transformational leadership, idealized influence means that transformational leaders have a clear vision and a sense of purpose and are role models with whom followers identify. Inspirational motivation is shown through clear communication of expectations and the generation of enthusiasm to demonstrate a commitment to a common goal. Transformational leaders stimulate their followers to be creative and promote new ideas and ways of doing things through intellectual stimulation. This skill set is complemented by individualized consideration, which highlights a supportive climate and the attribute of paying attention to the needs and development of others (Stewart, 2006). We summarized various transformational leadership characteristics based on existing research within the dimensions of idealized influence, inspirational motivation, individual consideration, and intellectual stimulation.

The orientation towards the employee is a central element directly described within individual consideration. However, transformational leaders are also concerned with generating a high level of performance from their followers through indirect measures such as creating a clear sense of purpose (Stewart, 2006), motivating and inspiring (Hay, 2006), ultimately leading to increased creativity and innovation capability (Bass & Avolio, 1990). Transformational leaders create the necessary boundary conditions without detailed instructions on how to reach the given goal. Nevertheless, their attitude promotes an environment that motivates employees to achieve those goals based on their distinct approaches. According to Hay (2006), followers gain confidence in transformational leaders, the baseline for accepting change.

Leadership for digital servitization

Despite the recognized complexity (Jovanovic et al., 2022) and difficulty of managing digital servitization (Kohtamäki et al., 2021), current scientific research so far lacks holistic perspectives on required leadership aspects or recommendations for specific leadership styles for

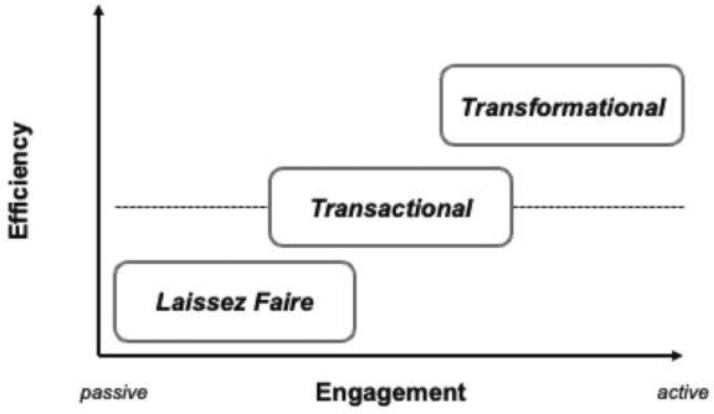

Fig. 1. Full Range Leadership Model - own illustration based on Banerjee et al. (2019); Kirkbride (2006).

digital servitization. Nevertheless, several researchers outline specific aspects associated with topics such as organization (Sklyar et al., 2019), tensions in digital servitization (Tóth et al., 2022), dynamic capabilities (Coreynen et al., 2020), organizational change framework (Bustinza et al., 2018), competence development (Cimini et al., 2021), and capabilities supporting digital servitization (Marcon et al., 2022). Table 2 summarizes our findings to represent the current scientific findings about leadership aspects for digital servitization.

Despite many listed aspects, we can identify patterns of frequently mentioned leadership subjects concerning digital servitization. Firstly, several authors emphasize the importance of creating a compelling vision for digital servitization (Chirumalla et al., 2023; Favoretto et al., 2022; Marcon et al., 2022; Pham & Vu, 2022; Sklyar et al., 2019; Tronvoll et al., 2020). The vision for digital servitization serves multiple purposes, such as legitimization (Tronvoll et al., 2020) and guidance for change (Sklyar et al., 2019), which is also deeply anchored in the definition of a transformational leader (Kirkbride, 2006). Furthermore, extant literature describes significant organizational change processes as a result of the digital servitization journey (Bustinza et al., 2018; Coreynen et al., 2020; Favoretto et al., 2022; Kim & Toya, 2018; Marcon et al., 2022; Tronvoll et al., 2020). Leaders are asked to actively manage the change on a strategic, organizational, and personal level arising from the convergence of the two subjects, digitalization and servitization (Bustinza et al., 2018). These requirements fit the description of a transformational leader (Hechanova & Cementina-Olpoc, 2013).

Another aspect frequently mentioned refers to the need for promoting internal and external collaboration for organizations in the context of digital servitization (Cimini et al., 2021; Favoretto et al., 2022; Marcon et al., 2022; Pham & Vu, 2022; Sklyar et al., 2019; Tóth et al., 2022; Tronvoll et al., 2020). Especially opening up and collaborating within ecosystems across organizational boundaries is a critical success factor for digital servitization (Pham & Vu, 2022; Tóth et al., 2022). Besides the ecosystems perspective, Sklyar et al. (2019) also outline the importance of close intra-firm collaboration between organizational units and departments. An area that has been finding lesser attention in digital servitization research so far is the focus on soft skills. Cimini et al. (2021) recommend finding the right balance between technical and soft skills and argue that underestimating soft skills is a challenge for companies undergoing digital servitization. In their study on transformational shifts through digital servitization, Tronvoll et al. (2020) recognize the close link between applying soft and social skills and the success of change initiatives for digital servitization.

Existing research positively relates digital servitization with an innovative (Marcon et al., 2022; Pham & Vu, 2022; Tronvoll et al., 2020) and entrepreneurial mindset (Favoretto et al., 2022; Tronvoll et al., 2020) for leadership. Especially the openness to innovation (Marcon et al., 2022) and the ability to create an environment for innovation deployment (Pham & Vu, 2022) are vital aspects that leaders and organizations should recognize for digital servitization. Similar to the previously mentioned leadership aspects, the innovation characteristics also fit the intellectual stimulation dimension of a transformational leader (Gumusluoglu & Ilsev, 2009; Stewart, 2006). In summary, despite not being specifically mentioned in the extant literature, we can match several discussed leadership characteristics for digital servitization to transformational leadership attributes.

Despite outlining various leadership characteristics promoting digital servitization, existing research lacks specific research emphasis on leadership skills for digital servitization as the primary research objective. Furthermore, as leadership encompasses a wide array of characteristics and styles (Piwowar-Sulej & Iqbal, 2023), a more structured approach is required to guide how to succeed in digital servitization. Thus, our research focused on transformational leadership to contribute to the existing research gap. The specific structure and focus on a dedicated leadership style aid in guiding practitioners in overcoming the current complexity and difficulties of implementing digital servitization business models.

Methods

Data collection

The selection process for our research participants for the semi-structured interviews followed the concept of purposive sampling (Etikan et al., 2016). We contacted potential research participants through the business-focused platform "LinkedIn" searching for "digital services," "servitization," "digitalization," and "digital transformation" in job titles. We ensured they matched our target group by initial questioning. This approach warrants sufficient knowledge and experience to contribute to our qualitative research (Bernard, 2017). One researcher conducted and recorded the interviews from April 2023 to July 2023 via the program "Microsoft Teams." The raw data of the transcripts was enhanced using the intelligent verbatim transcription method (McMullin, 2023) with the support of the MAXQDA program (VERBI Software, 2021). We reached code saturation after thirty interviews.

Our interview guideline consists of open-ended questions to answer our research question about which aspects of transformational leadership support digital servitization. With open-ended questions, we certify that the answers provide the necessary exploratory background on why the leaders responded this way, as digital servitization is still a new research area. The semi-structured interviews followed the logic of starting with a short introduction to familiarize with the research participant and the inquiry about the demographical background, such as hierarchy level or industry association. Afterward, we created a common understanding of the research subjects of digital servitization and transformational leadership by outlining and discussing their definitions. Thus, this increases reliability and validity by ensuring the researcher and research participant have the same understanding of the research topic. The first substantial question was intentionally kept general, inquiring about the required leadership skills for digital servitization. After that, the outlined transformational leadership dimensions (Idealized Influence, Inspirational Motivation, Individual Consideration, and Intellectual Stimulation; see also Table 1) served as a baseline to derive the following open-ended interview questions. We included probing questions to deepen the understanding and nuances of the participants' responses further (Adams, 2015). Following this section,

Table 1
Characteristics of transformational leadership based on Avolio et al. (1991); Bass and Avolio (1990); Hay (2006); Kirkbride (2006); Stewart (2006).

Transformational leadership dimension	Transformational leadership characteristics
Idealized influence	• being a role model • having a clear vision • creating a sense of purpose • obtaining the required extra effort from followers • being emotionally mature
Inspirational motivation	• being able to attract and inspire others • being an effective communicator • generating optimism and enthusiasm • demonstrating commitment to goals • setting an example of a hard worker
Individual consideration	• being considerate of the personal needs of employees • being an active listener • mentoring • promoting self-development • listening to all viewpoints to develop a spirit of cooperation • establishing a supportive climate • building individuals' confidence
Intellectual stimulation	• fostering creativity and innovation • soliciting new ideas • encouraging a new look at old problems • being open to the ideas of followers

Table 2
Literature review on leadership aspects for digital servitization.

Reference	Leadership aspects
Tronvoll et al. (2020)	• Transformational shifts • Collaboration • Agility • Vision • Focus on soft & social skills • Entrepreneurial culture • Innovation • Discipline • Change management
Sklyar et al. (2019)	• Collaboration • Trust • Vision for change • Sharing of knowledge
Pham and Vu (2022)	• Organizational transformation • Collaboration with ecosystem • Vision • Environment for innovation deployment
Tóth et al. (2022)	• Complexity to intra-organizational relationships • Resistance to change • Multi-actor involvement • Balance openness and control • Strong stakeholder management skills • Collaboration
Coreynen et al. (2020)	• Strategic change • Flexibility • Adaptability
Bustinza et al. (2018)	• Organizational change process • Constantly reconfiguring the firm's strategic capabilities • Long-term commitment to digital servitization • Strategic agility & flexibility
Cimini et al. (2021)	• Communication skills • Ambiguity tolerance • Agile and collaborative mindset • Cultural shift • Soft skills are underestimated but highly important
Favoretto et al. (2022)	• Vision • Collaboration • Commitment • Agility • Entrepreneurship • Change culture
Chirumalla et al. (2023)	• Vision • Flexibility
Marcon et al. (2022)	• Openness for innovation • Know-how development • Collaboration • Shared vision • Business model change
Kim and Toya (2018)	• Charisma • Organizational change • Soft skills

we concluded the interview's main section with a question about the fit of transactional leadership for digital servitization to gain insights into the interview partners' opinions on the opposing leadership style compared to transformational leadership. We further increased the study's reliability as the quality and understanding of the respondents' statements were additionally challenged and verified. Lastly, we asked about additional insights that were not covered and concluded the interview.

We can classify the research participants based on their company rank, industry, and years of leadership experience (Table 3). Our digital servitization leaders can be attributed to different company levels, ranging from first-level Managers to Vice Presidents and Executives. We considered an even allocation between company levels based on the distribution among the different ranks. For classifying our thirty research participants to the industry, we used the Global Industry Classification Standard (GICS) as a globally valid standard (MSCI, 2022). Most of our research participants were active in the machinery, automobile, or electrical equipment industry, which can be seen as a

Table 3
Research participants.

Company level	Number	Share in %
Executive	6	20 %
Vice President	5	17 %
Director	6	20 %
Head of …	7	23 %
Manager	6	20 %
Total	**30**	**100 %**
Industrial sector	**Amount**	**Share in %**
Professional Services	5	17 %
Machinery	15	50 %
Automobiles & Components	1	3 %
Chemicals	2	7 %
Electrical Equipment	3	10 %
IT Services	4	13 %
Total	**30**	**100 %**
Leadership experience	**Amount**	**Share in %**
<5 years	6	20 %
6–10 years	6	20 %
11–20 years	10	33 %
>20 years	8	27 %
Total	**30**	**100 %**
Gender	**Amount**	**Share in %**
Female	6	20 %
Male	24	80 %
Total	**30**	**100 %**

focus area of digital servitization. Another category included consultants active in business and IT, supporting their clients in digital servitization activities, classified as professional or IT services. Another criterion for clustering our research participants is their leadership track record, measured in years of leadership experience. Whereas six research participants were at the beginning of their leadership career (<5 years), sixty percent of the respondents had more than ten years of leadership experience. A balanced distribution, including younger leaders, represents recently developed leadership concepts and approaches. Lastly, six of our research participants were female, whereas twenty-six were male.

Data analysis

We analyzed our data set based on thematic analysis following Braun and Clarke (2006). More specifically, we applied a hybrid approach of deductive (Crabtree & Miller, 1992) and inductive (Boyatzis, 1998) thematic analysis. We chose this combined approach to analyze the responses to answer our research question (Fereday & Muir-Cochrane, 2006). On the one hand, we used our outlined transformational leadership characteristics (Table 1) as a template from a deductive view. We counted the references of the specific attributes of the four I's (idealized influence, inspirational motivation, individual consideration, and intellectual stimulation) within the transcripts. On the other hand, we reviewed the data set inductively by adding attributes to the transformational leadership categories mentioned during the interviews. The results were structured with a three-stage system summarizing the original codes into themes, which were further aggregated into dimensions (Gioia et al., 2013). Within the analysis, we excluded initially created codes, which resulted in five or fewer counts due to their statistical relevance. Furthermore, we added a coding in shades of grey based on the number of counts for which the specific code is used in our analyses (Brauer et al., 2021). Lastly, we included a question on the fit of transactional leadership for digital servitization in our questionnaire, in which we summarize the statements inductively as a separate category in the results section. Researcher bias was addressed through an intercoder check between the research partners, which resulted in agreement on the coding results (Mayring, 2014).

Results

The following will present our results by displaying the deductive and inductive thematic analysis for digital servitization and transformational leadership (the data and analyses are also to be found here: https://osf.io/5y4xg/?view_only=48a7e578bfd0470daf81b66002d9fcd4).

The following section shows the characteristics mentioned by our research participants as applicable use cases for transactional leadership in digital servitization.

Transformational leadership for digital servitization

Fig. 2 depicts our results of the deductive and inductive analysis. Besides structuring our findings into initial codes, themes, and dimensions, we add further information to the structure. On the one hand, we describe whether the code originates from the deductive or inductive analysis. If derived from the deductive analysis on transformational leadership characteristics, we add the information to which dimension (idealized influence, inspirational motivation, individual consideration, or intellectual stimulation) we classified the code in Table 1. On the other hand, we depict the number of codes that were applied during the coding process. We structured the coding numbers into categories and included a coloring label to better identify frequently mentioned items. We organized our coding scheme into three dimensions: *giving direction, being employee-oriented*, and *creating an innovative and collaborative environment*. Furthermore, each dimension is further detailed by themes and the corresponding initial codes.

Leaders should be able to *create a vision* and *be goal-oriented* within the dimension of *giving direction. Having a clear vision* was identified as a critical leadership characteristic associated with digital servitization. As it is one of the most mentioned characteristics within the analysis, we see it as a crucial success factor for digital servitization. The interviewed digital servitization leaders emphasized this by statements such as "you need to have a strong vision" (Interview #22), "it is about the vision" (Interview #16), or "you need to have a clear vision, and you need to be able to communicate that vision (Interview #3)." *Demonstrating commitment to goals* is complementary to creating a vision to ensure digital servitization is pursued effectively to achieve the desired targets. For example, one research participant emphasized, "you still need to set clear targets and expectations, so it does not go off in the wrong direction (Interview #21)." "You need to have the leadership skills that you can make the whole organization work towards that goal (Interview #13)" is another reference made by a Manager in the machinery industry. The second theme summarizes the leadership skills to *motivate employees* for digital servitization. Within this theme, leaders should consider multiple aspects from the deductive analysis of transformational leadership characteristics. Our research participants especially emphasized the two subjects of *being a role model* and *being able to attract and inspire others* based on the number of codes. A statement mentioned multiple times in the context of role modeling is "leading by example (Interview #4, #11, #15)." The other codes associated with the theme of motivating employees, *creating a sense of purpose, obtaining extra effort from followers*, and *generating optimism and enthusiasm* received fewer individual mentions than those outlined before. In the theme of *allowing for freedom*, we summarized the three leadership characteristics: *creating freedom within boundaries, empowering employees*, and *enabling employees*. Those provide further details to the previously mentioned ability to formulate a clear vision by leadership but grant employees the autonomy to work towards the agreed targets independently. For example, leaders "should not do everything on [their] own, but enable the people (Interview #27)," or "leadership means setting boundaries where you want to go but also giving people the freedom (Interview #2)."

The second dimension, being employee-oriented, summarizes the two themes *applying soft skills* and *driving change*. By explicitly outlining specific aspects of soft skills, our findings explain details which skills especially support the organizational change process around digital servitization, which extant literature describes as critical but underestimated (Cimini et al., 2021; Tronvoll et al., 2020). A code arising from the transformational leadership dimension of individual consideration, *being considerate of employees' personal needs*, received more than twenty

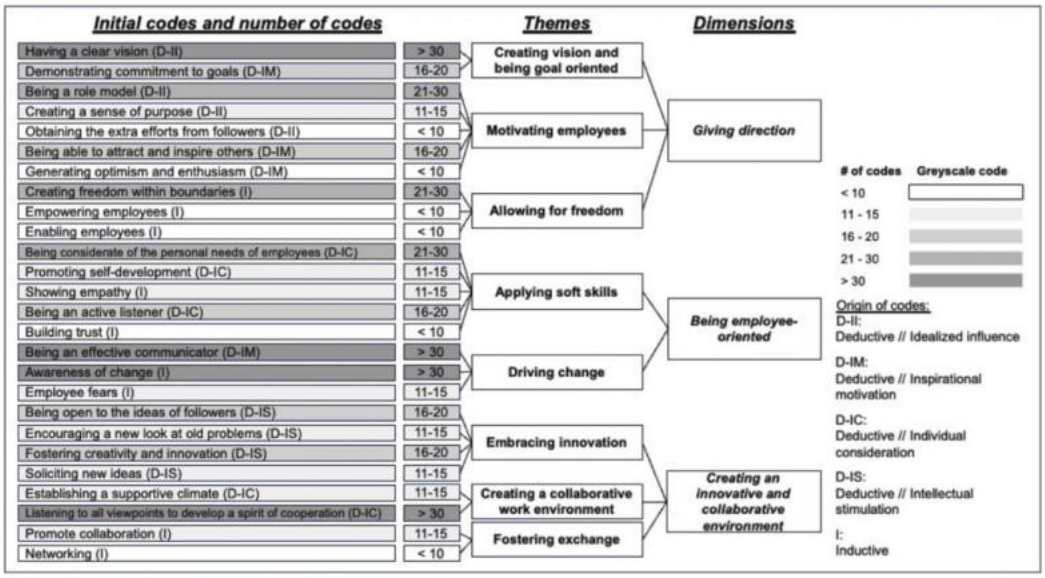

Fig. 2. Results of deductive and inductive analysis—transformational leadership for digital servitization.

codes, thus showing significant importance for leading digital servitization. For example, one Manager emphasized: "I try to understand what is important for people (Interview #9)." Another perspective from a Director outlined that "it is a lot about personal contact and always understanding what drives them (Interview #7)." In conjunction with *promoting self-development, showing empathy, being an active listener*, and *building trust*, we outline specific attributes leaders should consider in their relationships with their teams and employees. Those can also be seen as foundational blocks for the theme *driving change*. Mainly driven by the significantly changing business models and job descriptions of employees, leaders must focus on change management, which is associated with digital servitization (Bustinza et al., 2018; Kim & Toya, 2018). Furthermore, leaders should consider *employees' fears* arising from digital servitization changes. One executive stated that "change very often also creates fear (Interview #18)", which underlines our previous statement. Our research participants saw a critical success factor in *being an effective communicator*. A Manager in the IT services industry mentioned, "[…] you also need to understand that communication, effective communication is a critical success factor for change management (Interview #25)". Furthermore, communication also links to the topic of vision, as one Director mentioned, "[…] making a vision come to life (Interview #26)". Based on our analysis's high number of codes, we can conclude that focusing highly on employees and their well-being and communication are central success factors in applying transformational leadership for digital servitization.

The third dimension was labeled *creating an innovative and collaborative environment*. Mainly from the transformational leadership dimension of intellectual stimulation, the codes associated with *embracing innovation* received similar codes in the medium range compared to other items. All four characteristics, *fostering creativity and innovation, soliciting new ideas, encouraging a fresh look at old problems,* and *being open to the ideas of followers,* should be considered by leaders to complement their skills to advance digital servitization. Even though digital servitization offers new business model capabilities, our research participants did not perceive spurring innovation and creativity as the utmost priority for leadership priorities. Nevertheless, leaders must keep this transformational leadership dimension on the radar to complement their skills for digital servitization. One research participant stated, "[…] you have to be truly open-minded and have to see all the possibilities that are outside the box (Interview #13)." Another executive confirmed the link between digital servitization and innovation: "One thing is when we want further to drive this kind of service products to the market, then I think that has to do a lot with innovation. The required competencies are computation, curiosity, and creativity, but also topics like risk-taking (Interview #8)." The second theme, *creating a collaborative work environment,* entails *establishing a supportive climate* and *listening to all viewpoints to develop a spirit of cooperation*. The latter of the two was coded more than thirty times, highlighting the importance of this transformational leadership characteristic for digital servitization for our research participants. One Manager emphasized the need for close cooperation and listening to each other: "Work with your employees and try to understand together with them (Interview #25)", which is also underlined by a statement from an Executive: "It is usually better to create it together with the people to bring in different perspectives (Interview #15)." Lastly, leadership for digital servitization requires *fostering exchange* through *promoting collaboration* and *networking*. Leaders should encourage the exchange between departments, disciplines, and different business units, primarily driven by the cross-functional characteristic of digital servitization.

Transactional leadership for digital servitization

As a complementary analysis, we summarized our research participants' statements regarding the fit of transactional leadership for digital servitization. Even though some characteristics were only mentioned once or twice, certain elements gained significant mentions, highlighting the situational awareness needed to distinguish between transactional and transformational leadership for digital servitization. We clustered the identified items based on the associated context in Table 4.

We classified the responses from three of our research participants as *goal context*. This implies the argument that transactional leadership fits digital servitization if there is a *defined end goal* and it is suitable for *goal achievement*. In this context, transactional leadership aspects can be applied if the innovation character of the digital servitization activities is incremental, thus requiring less transformational leadership attributes. Eight responses were associated with *application context,* meaning there can be certain situations where leaders are better equipped with transactional leadership characteristics than transformational leadership. For example, one research participant saw benefits in applying transactional leadership elements in leading *data analytics* tasks due to the high expertise and structure required. Another research participant preferred the leadership style for *setting up structures*. Within this data set, a significant mention of five codes is the application of transactional leadership for *crisis mode,* for which existing research sees advantages over transformational leadership (Anwar, 2017). For instance, this could occur with failing data connections or customer relationship issues within digital servitization business models. A research participant's statement underlines this: "If something is not working and there is a loss at the customer because the machine stands still, you cannot be creative for months until you come up with a solution there. I think immediate action is required, and you are coming up with strict follow-up and ToDos (Interview #2)." Another research participant preferred aspects of transactional leadership for structured *problem-solving*, which can also be associated with emergencies or failures. This analysis's highest number of codes is attributed to the *time context*. Several leaders recognized a difference between *different stages* of the digital servitization journey, thus requiring a shift from a transformational to a transactional leadership style. Especially once the initial development of the business model is successful, our research participants recommended gradually shifting from transformational to transactional leadership elements for *scaling, implementing,* and *improving* the existing business models. A Director mentioned, "towards the end of an implementation, or the more it is about implementing it, just scaling it up, the more transactional elements could fit in (Interview #2)." We connected four responses with the *people context*, meaning that our research participants emphasized the need to apply transactional leadership for specific groups within digital servitization. On the one hand, two research participants recommended using more transactional leadership elements for *sales and service employees*. On the other hand, two leaders pointed out that *cultural differences* require a more transactional leadership approach for certain cultures. Finally, two of our

Table 4
Transactional leadership for digital servitization.

Context	Characteristic	# of total codes
Goal context	Defined end goal	2
	Goal achievement	1
	Subtotal	*3*
Application context	Data analytics	1
	Setup structures	1
	Crisis mode	5
	Problem-solving	1
	Subtotal	*8*
Time context	Scaling	3
	Different stages	1
	Implementation & improving	7
	Subtotal	*11*
People context	Cultural differences	*2*
	Sales & service personnel	2
	Subtotal	*4*
No fit for digital servitization		*2*
Total		**28**

research participants emphasized seeing *no fit for transactional leadership regarding digital servitization.*

Discussion

Based on the three analyses described, we summarized our findings on connecting transformational leadership to digital servitization in Fig. 3. Based on the most mentioned leadership characteristics from the deductive analysis, we enhanced the depiction by adding frequently stated activities from the inductive analysis. Lastly, we pointed out the use cases where our research participants saw high applicability of transactional leadership for digital servitization.

Our findings summarize that the effective application of transformational leadership for digital servitization consists of three focus areas. Firstly, leaders should give direction to their employees by creating a compelling vision for digital servitization within the company. Thus, our findings agree with discussions in extant literature describing vision as a vital success factor for digital servitization (Chirumalla et al., 2023; Sklyar et al., 2019; Tronvoll et al., 2020). Within this vision, we summarized that employees must be given freedom within the aligned boundaries. This emphasizes a clear tendency towards the fit of transformational leadership, whereas transactional leadership would imply a much stricter monitoring and deviation management (Bass et al., 2003; Kirkbride, 2006). Additionally, leaders should firmly commit to goals to succeed in digital servitization which is also outlined by Favoretto et al. (2022). Enriching the essential task of vision creation for digital servitization (Marcon et al., 2022; Pham & Vu, 2022; Tronvoll et al., 2020), with the additional transformational leadership characteristic of providing freedom within boundaries, we provide further and more specific context to the more high-level topic of vision creation. Additionally, leaders should focus on motivating their employees and act as role models to lead digital servitization activities.

Secondly, we derived a strong employee orientation to implement business models in the context of digital servitization. Consequently, understanding how to consider employees' personal needs and incorporate those into the leadership decision-making process is an essential leadership task. In line with the previous statement, leaders should take the time to listen to their employees. In the context of digital servitization, our research participants emphasized a vital need for communication skills, which fits the definition of a transformational leader (Hay, 2006). Digital servitization is a significant change process for the company and its employees. Thus, leaders must actively manage the inherent change process. With the leadership activities associated with the focus area of employee orientation, we provide further insights into the so far acknowledged but under-researched area of soft skills for digital servitization (Cimini et al., 2021).

As digitalization and servitization are two novel attributes for incumbent companies, we recommend focusing on creating an innovative and collaborative environment as a third focus area for leaders. Leaders enable innovations by supporting and creating collaboration within the firm and across organizational boundaries. Collaboration can be seen between individual employees, different departments, or across organizational borders with customers, suppliers, or other stakeholders. Our findings also correspond to the call by Pham and Vu (2022) to develop an environment for innovation deployment. Furthermore, leaders should be open to ideas and feedback on a continued basis. These aspects align with the transformational leadership characteristics of cooperation and establishing a supportive climate (Stewart, 2006) and are also underscored by the research work of Sklyar et al. (2019) describing the need for increased intra-firm collaboration and cooperation in ecosystems.

Besides the strong correlation between transformational leadership attributes, we recommend using certain transactional leadership aspects for specific use cases within the digital servitization journey. After a certain amount of time, the innovative character of digital servitization will decrease, and specific business models will be seen as part of regular business operations. Therefore, after building the business model, transactional leadership skills support implementing, scaling, and improving digital servitization activities. Another essential use case is the use of transactional leadership in crisis scenarios during digital servitization to ensure clear guidance and order to solve the present situation.

Based on the outlined leadership aspects, we recommend applying transformational leadership characteristics to build digital servitization business models. Furthermore, guiding the inherent change through giving direction and employee orientation is attributable to transformational leaders. Nevertheless, we conclude that transactional leadership aspects find their use cases for maintaining the business model, such as improving or managing crises. Therefore, the more the maturity level for digital servitization increases, the more transactional leadership elements support further scaling the business. Our findings align with existing research that recommends that the effectiveness of transformational and transactional leadership styles depends on situational use and environmental factors. For example, this relates to regional characteristics (Wamalwa, 2023), aiming at exploration or exploitation activities (Asif, 2019; Hoessler & Carbon, 2024), or industry-specific differences (Abbas & Ali, 2023).

Furthermore, putting our findings in a broader context of existing research on leadership in general and leadership for digitalization, we

Fig. 3. Focus areas for leadership for digital servitization (own illustration based on the empirical findings).

find the following conclusions. The focus area of giving direction that we outlined as crucial for leading digital servitization, mainly including the aspect of creating a vision, is also often referred to in research on leading digital transformation (Cortellazzo et al., 2019; Klein, 2020; Larjovuori et al., 2016; Sainger, 2018; Tagscherer & Carbon, 2023). In the same context, change management as part of being employee-oriented correlates with findings of extant digital leadership research that sees embracing and managing change as a central leadership characteristic (Kane et al., 2019; Porfirio et al., 2021; Shah & Patki, 2020; Zulu & Khosrowshahi, 2021). For leading digitalization activities, previous research has indicated transformational leadership as well suited (Diller et al., 2020; McCarthy et al., 2022; Philip, 2021; Sow & Aborbie, 2018), which we also confirmed for digital servitization as a sub-topic of digitalization. Compared to the original works of transformational leadership (Bass, 1985; Bass & Avolio, 1990; Hay, 2006), creating a strong vision, being an effective communicator, and the consideration of employees' needs is shared with the presentation of our results of leadership skills for digital servitization. However, established leadership research has not explicitly described change management and innovation-orientation characteristics. Nevertheless, those skills have become more relevant with the rising interest in digitalization. Therefore, our research outcomes of transformational leadership skills for digital servitization expand the existing leadership by considering current industry movements.

Regional or cultural differences in leadership effectiveness are acknowledged in research areas neighboring leading digital servitization. For example, Espina-Romero et al. (2023) offered insights into cultural differences in digital leadership. In servitization research, Kim and Toya (2018) concluded that transformational leadership supports advancing servitization in Japanese manufacturing firms. Also, the effectiveness of transformational leadership among different cultures was reviewed by Budur (2020), who concluded that transformational leadership is more effective in low-avoidance cultures. On the contrary, cultures with high power distance are more suited to transactional leadership styles. Moreover, the advancements in digitalization vary between countries based on regional development and maturity levels (Boikova et al., 2021).

Conclusion

Our research was targeted to contribute to existing digital servitization research, especially the under-researched area of managing the inherent complexity of digital servitization (Tóth et al., 2022; Tronvoll et al., 2020), by elaborating on transformational leadership style and especially which specific attributes support leaders in digital servitization activities. Through conducting 30 semi-structured interviews, we gained valuable insights from leaders involved in digital servitization initiatives within their companies. Based on analyzing the interview transcripts deductively and inductively, we derived a set of leadership attributes our experts saw as important for digital servitization. Therefore, we can conclude that transformational leadership can be seen as a supportive pathway approaching and building digital servitization business models. Formulating a vision and focusing on change management are vital elements for leaders in digital servitization, simultaneously being closely associated with a transformational leader (Hay, 2006; Kirkbride, 2006). Through applying the specific lens of leadership for digital servitization, we present three focus areas: giving direction, being employee-oriented, and creating an innovative and collaborative environment, including the corresponding activities (see Figs. 2 and 3).

Furthermore, we confirm the findings of previous digital servitization research outlining creating a vision (Favoretto et al., 2022; Marcon et al., 2022; Pham & Vu, 2022; Sklyar et al., 2019; Tronvoll et al., 2020), internal and external collaboration (Cimini et al., 2021; Favoretto et al., 2022; Marcon et al., 2022; Pham & Vu, 2022; Sklyar et al., 2019; Tóth et al., 2022; Tronvoll et al., 2020), and organizational change (Bustinza et al., 2018; Coreynen et al., 2020; Favoretto et al., 2022; Kim & Toya, 2018; Marcon et al., 2022; Tronvoll et al., 2020) as critical success factors for digital servitization. Nevertheless, we combine all those elements with further aspects, such as an innovative environment and, especially, detailing the under-researched aspect of soft skills (Cimini et al., 2021) within the view of transformational leadership. Moreover, by including the specific use cases for transactional leadership, such as maintaining and scaling business models or managing crises in digital servitization, we provide a differentiated view and situational requirements for leaders to shift their approach.

From a theoretical perspective, our findings contribute to the scientific discussion on digital servitization. Linking digital servitization with leadership provides a better understanding of why several authors considered implementing digital servitization business models complex (Gebauer et al., 2021; Tóth et al., 2022; Tronvoll et al., 2020). The intersection of digitalization and servitization as a significant disruption of companies' competitive landscape requires a holistic leadership approach involving multiple facets such as change management, innovation, or commitment to goals. Furthermore, using transformational leadership as a specific research direction presents a distinct and actionable approach for use cases in leading digitalization activities. Expanding those thoughts opens the door for future research in this direction. Outlining the most relevant transformational leadership aspects for digital servitization through the thematic analysis provides a structure that can be used as a template for other use cases of transformational leadership or other digitalization activities.

Practitioners can also gain insights from our research. On the one hand, we propose applying transformational leadership elements to approach digital servitization. Moreover, boards and top management are supported by assigning transformational rather than transactional leaders to lead companies' digital servitization initiatives. On the other hand, leaders better understand the required focus areas for digital servitization: Giving direction, being employee-oriented, and creating an innovative and collaborative environment. When applying the associated leadership activities, leaders have better guidance on approaching and managing digital servitization. Besides focusing on strategic and technical advancements, ensuring that soft skills are applied to involve employees and stakeholders is a vital success factor for the required organizational change towards digital servitization. Finally, specific use cases requiring transactional leadership support more explicit decision-making in crisis scenarios. It reminds organizations to constantly re-evaluate whether digital servitization initiatives have matured and should be treated more with transactional leadership elements. Our study contributes to practitioners by providing a structured roadmap, including central leadership aspects and skills to advance digital servitization business models within their companies.

From a social perspective, our research findings also provide value to extant literature. On the one hand, we specifically outline the consideration of employees' needs and listening to them as key success factors in leadership for digital servitization. This offers a human perspective within our fast-paced environment and contributes to managing employees' stress levels (Harahap et al., 2023). Transformational leadership's distinct focus on those social-oriented subjects improves employee well-being within companies (Arnold, 2017), especially in the context of digital servitization activities. Also, creating a collaborative work environment, which we outlined as a success factor for digital servitization, creates an inclusive work atmosphere. On the other hand, effective leadership in digital servitization activities allows advancements in sustainability (Lyu, 2024) by providing proper resource allocation strategies. Thus, it indirectly supports the efficient use of energy due to the resource intensity of digitalization (Deming et al., 2023).

Limitations and further research implications

Although applying a well-established qualitative scientific research approach through semi-structured interviews and analyzing them by content analysis, we acknowledge the limitations of our study. Firstly,

although conducting thirty interviews represents a significant foundation of data collection, our chosen qualitative research method is incumbent on its restrictions of statistical validity. The selection of research participants through purposive sampling offers the risk of biased and unbalanced research data. However, our research participants represent different hierarchical levels, industries, and leadership track records, thus covering a wide range of expertise. Also, initial questioning before conducting the interview ensured the research participants' knowledge of digital servitization and leadership. Furthermore, gaining the insights of thirty leaders in digital servitization offers more diverse insights than case-study-based research in extant literature covering only a few companies. As we pursued gaining insights from different industries, management levels, or leadership experience, we did not specify or cluster our research findings according to those categories. Focusing on a dedicated industry would offer further research possibilities to provide more details on our findings. Additionally, a deductive approach in our first analysis initially limits the results based on the defined coding criteria. However, establishing them on a literature review (see Table 1), adding an inductive analysis of our data set, and analyzing the responses concerning transactional leadership negates these restrictions. Also, linking several of our identified results to existing research on digital servitization solidifies our results.

Although our findings contribute to the identified research gap on managing and guiding the complexity of digital servitization (Gebauer et al., 2021; Tóth et al., 2022; Tronvoll et al., 2020) by identifying transformational leadership style as a viable orientation, we recommend further research to the digital servitization research community. We suggest deepening the convergence of digital servitization and leadership research. As indicated earlier, the selected research method and purposive sampling aimed to gain balanced insights across industries or geographical regions. A more specific and deepened understanding of individual industries offers future research potential. For example, additional research could compare the degree of specific transformational or transactional leadership attributes between the machinery and the electrical equipment industry sectors. As our research participants acknowledged potential regional differences in the effectiveness of transformational leadership, we propose research that differentiates leadership styles for digital servitization across geographical regions. The specific research could benefit the scientific community when industry or regional-specific findings can be abstracted to the discourse on leading digital transformation.

Digital servitization has been recognized as an organizational change process (Bustinza et al., 2018). However, we recommend conducting further research on how leadership influences the acceptance of organizational change and the subsequent success in digital servitization. Furthermore, we see benefits in focusing on leaders as individuals and their required skill sets as they are responsible for driving change within organizations (Faix, 2020).

Despite offering more concrete details on the required leadership soft skills for digital servitization, we acknowledge the need for further research. On top of our exploratory research outcomes for soft skills for digital servitization, using a quantitative research design will gain further and statistically rich data. Lastly, we recommend further research on the gradual shift from transformational to transactional leadership based on the maturity stage of digital servitization, providing more insights into time frames or trigger points for adapting the leadership style.

CRediT authorship contribution statement

Florian Tagscherer: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Claus-Christian Carbon:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.stae.2025.100098.

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