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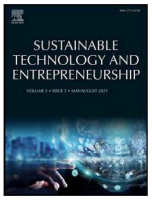

Review

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 skillset 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

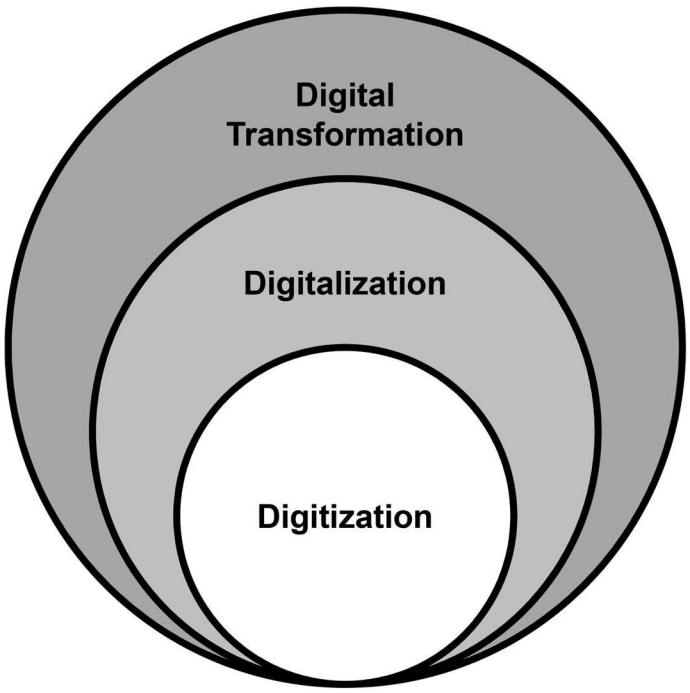

Fig. 1. Digitization, Digitalization, Digital Transformation (own depiction, based on Saarikko et al. (2020)).

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)

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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; Rüth & 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;

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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

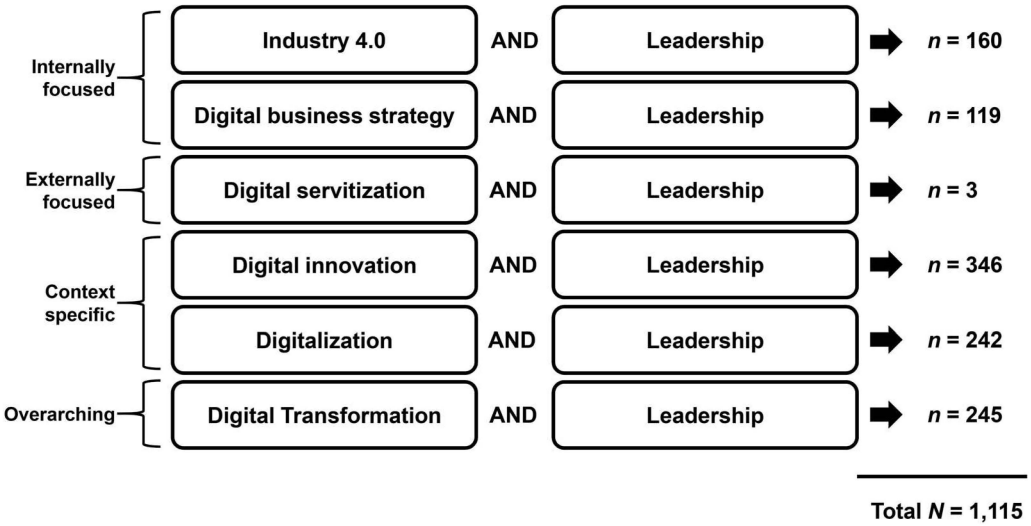

Fig. 2. Search terms employed to gather initial search results.

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

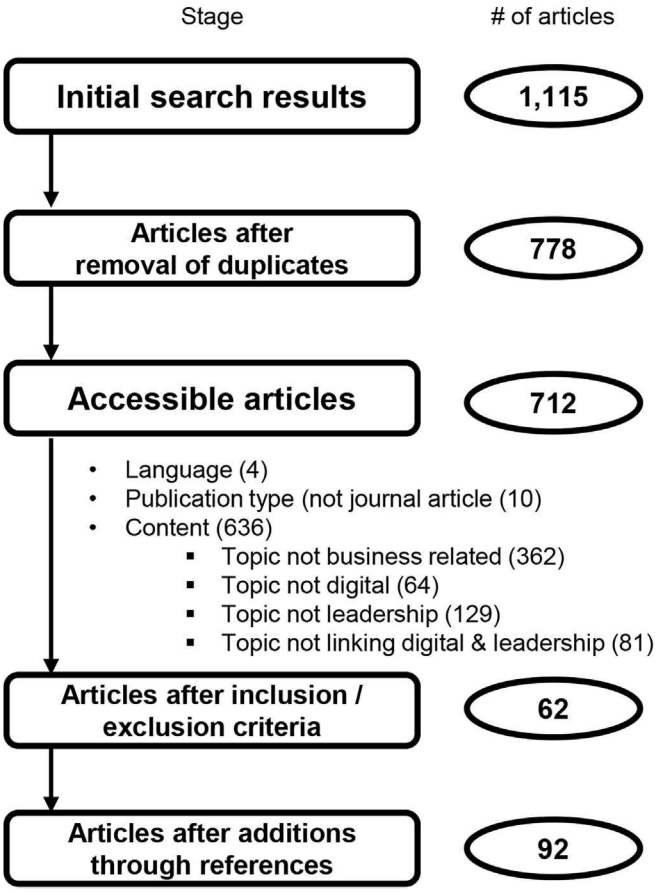

Fig. 3. Results of the literature review process.

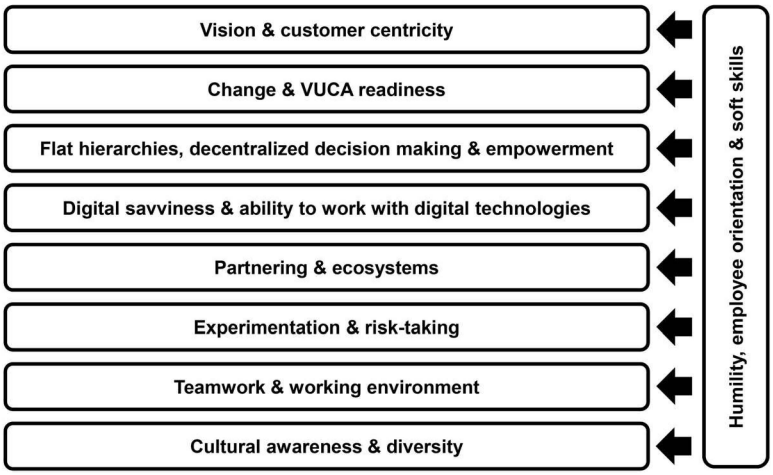

Fig. 4. Nine themes for leadership of internal and external digitalization.

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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