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The digital leadership emerging construct: a multi-method approach

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Abstract
This study presents new insights into the capabilities that a leader needs to thrive in the digital scenario. These insights come from a systematic literature review of 21-years of publications on leadership in the digital environment that supports a four-round Delphi study with a panel of 24 experts from diverse geographical backgrounds (six countries across 3 continents). The e-leadership concept has evolved to digital leadership by transitioning from an electronic way of communication to a broader context of how to lead effectively in a digital environment. Digital leadership is a way of thinking and behaving in a complex time. The findings show that digital leadership has two main aspects within four dimensions: the first aspect is related to business, and it is strategy focused and delivery related; the second one involves personal attributes, and it is interpersonal oriented. Moreover, we identify the associated leadership capabilities for each of these aspects.

Keywords Digital leadership · E-leadership · Capabilities · Delphi · Systematic literature review

JEL Classification M50

1 Introduction

Digital transformation influences how people work, interact and think (Hai et al. 2021). The traditional leadership mindsets approaches are insufficient in the era of highly uncertain and rapid changing business settings (Kane et al. 2019). Leadership must adapt how

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to work in the digital environment to obtain an effective long-lasting performance (Contreras et al. 2020). Besides, organizations must be aware of the main leadership capabilities that managers need to thrive in that environment (Cortellazzo et al. 2019). Capability is a condition or potential condition (physical or mental) can be turned to use (Bolton et al. 1999), and some authors use capability and competence interchangeably (Fowler et al. 2000). The digital environment provides challenges for leadership capabilities, and motivates their study (İnel 2019; Roman et al. 2019). As leadership is context-related, identifying the leadership capabilities needed nowadays and preparing the leaders to better perform their roles is crucial (Bolden and Regan 2016).

Literature is profuse in leadership and digital transformation studies focusing on communication (Braun et al. 2019; Darics 2020; Narbona 2016), technology (Larson and DeChurch 2020; Leduc et al. 2015), public administration (Banerjee and Chau 2004; Rubino-Hallman and Hanna 2007), SMEs (small-to-medium enterprises) (Belitski and Liversage 2019), and remote team (Cascio and Shurygailo 2003). Such topics have also produced several literature reviews (Avolio et al. 2014; Cortellazzo et al. 2019). Although there are studies regarding capabilities needed for working with virtual teams (Maduka et al. 2018; Roman et al. 2019), to date most studies have modestly analyzed how the digital transformation affects leadership capabilities from a broader perspective (Van Wart et al. 2017a; Schneider 2018). Despite there is a need for change in the traditional leadership mindsets to better perform in the digital environment (Kane et al. 2019), there is not a strong unifying theory of the relationship between leadership capabilities and digital transformation, calling for more attention to theoretical contributions (Cortellazzo et al. 2019). Moreover, it is an important topic in the effort to modernize organizations and it is worth considering in detail (Peng 2021). Thus, there is a gap in the literature to clarify the leadership capabilities needed in the digital scenario. This study aims to close the gap by identifying the leadership capabilities that managers need to thrive in the digital environment, and to add new insights to the leadership literature and for practitioners, responding to the following research question: What are the main leadership capabilities needed to thrive in the digital environment?

To address the research question, we have used a multi-method design that combines a systematic literature review with a Delphi study. Integrating a systematic literature review with a Delphi method is a used approach in the academy (e.g., Bhuyan et al. 2022; de Jesus et al. 2019), and specifically being used to identify capabilities in previous studies (e.g., Schulze and Bals 2020). A Delphi study with a systematic literature review is a recommended dual approach to improve the validity of the results (Dewar et al. 2017). The literature review is an important first stage, as it provides comprehensive information about the current knowledge of the topic (Novakowski and Wellar 2008). Afterward, the Delphi method supplements and validate the data collected by the literature review (Bhuyan et al. 2022). This sequence reduces the potential weakness in a solely Delphi study, as not having to rely exclusively on the initial questions asked to the experts to gather information about the subject (Miller 2001). Nonetheless, the Delphi method collects the experts' opinions regarding new concepts to deal with emerging trends (de Jesus et al. 2019). Finally, it is appropriate for studies seeking a collective perspective from experts aiming to obtain consensus (Miller 2001).

We conducted a review of 21 years of publications about the leader´s capabilities in the digital environment. We then conducted a Delphi study that engaged experts from six different countries on three continents (Chowdhury and Quaddus 2017). The study follows the structure in Corley and Gioia (2004) who organize data according to hierarchical categories to develop a theoretical understanding (Gioia et al. 2012). The Delphi study is one of the most common approaches to identify capabilities (Foth et al. 2016), so the social science research has increasingly used it (Hasson et al. 2000; Brady 2015). It is appropriate and useful in identifying, selecting, and validating the capabilities (e.g. Ahmad and Wong 2019; Egan and Akdere 2005; Hart 2010; Miller 2001; Okoli and Pawlowski 2004). Additionally, it is adequate in reaching consensus when there is uncertain information or a lack of empirical evidence and is an efficient way to integrate the knowledge and abilities of a panel of experts (Ahmad and Wong 2019). This qualitative approach has an inductive theoretical drive and is better suited for developing theory (Harrison and Rouse 2014). Further, it facilitates the discovery of multiple sources of data on a social phenomena (Bryman and Bell 2011) that increases the validity of an exploratory study (Papaoikonomou et al. 2011). Additionally, qualitative research has been used to study the leadership topic (e.g., Parry et al. 2014; Sumner-Armstrong et al. 2008; Zaar et al. 2020; Kessel and Graf-Vlachy 2021).

The remainder of this paper is structured as follows: The next section provides the background on e-leadership, digital leadership, and digital transformation. The systematic literature review is described in Sect. 3. Section 4 presents the Delphi study; Sects. 5 discuss the research findings, and conclusions are provided in Sect. 6.

2 Background

The emergence of information technology (e.g., internet, e-mail, and video conferencing) in the late 1990, undoubtedly changed the way people worked and it created the need for a new form of leadership, called e-leadership (Avolio et al. 2014). Therefore, many authors started to investigate the implications of information technology on leadership (Kissler 2001; Pulley and Sessa 2001; Avolio and Kahai 2003). Initially, they used the term e-leadership to refer to leaders who used electronic channels to facilitate global reach (Zaccaro and Bader 2003). E-leadership is usually defined as a social influence process that uses information technology to alter attitudes, feelings, thinking, behavior, and/or performance with individuals, groups, and/or organizations (Avolio et al. 2000; Fernandez and Jawadi 2015; Jiang et al. 2017; Leduc et al. 2015). However, recently the term digital leadership has appeared in the literature. Digital leadership is conceptualized as leaders operating with digital technologies (Narbona 2016). It is also a mixture of leadership capabilities and digital tools to assist the decision-making process (Sasmoko et al. 2019).

It was only after 2014 that the number of studies on digital transformation increased significantly (Reis et al. 2016). Further, in the last few years, digital transformation has become widespread among practitioners that has led to the need to change their business models in the digital world (Gurbaxani and Dunkle 2019). Digital transformation is the process of changing an entity through information,

computing, communication and connectivity technologies (Vial 2019). Examples of digital technologies are cloud computing, artificial intelligence, robotics, 3D printing, big data, and social media that has led to totally new products, services, and business models across industries (Matzler et al. 2018). It is not possible to discuss digital transformation without mentioning the term Industry 4.0, the increasing intelligence of products and systems and their intra-company and cross-company integration (Schneider 2018). In the twenty-first century, Industry 4.0 has heralded the end-to-end digitization and integration of digital industrial ecosystems by seeking completely integrated solutions (Xu et al. 2018).

With the increasing complexity of global business, organizations often experience numerous disruptions (Stone and Deadrick 2015; Matzler et al. 2018), which can have detrimental effects if their leaders do not address it in a proper and timely fashion (Colbert et al. 2016; Schwarzmüller et al. 2018; Roman et al. 2019). A skilled leadership is crucial in the digital scenario (Hanna 2018), thus mastering related capabilities to nowadays environment provide an enormous opportunity for increasing organizational effectiveness (Stone and Dulebohn 2013; Colbert et al. 2016). Therefore, it is mandatory to identify and understand the leadership capabilities that are needed to thrive in the digital era to achieve long-term success (Colbert et al. 2016; Sousa and Rocha 2019; Vial 2019).

The future of knowledge work is digital, and the COVID-19 pandemic has accelerated the digital transformation endeavor (Wang et al. 2020). Therefore, organizations have been forced to adapt to new ways of work (Hai et al. 2021). As technology is a situational context that creates conditions that affect social practices, the shape of leadership structures has changed (Larson and DeChurch 2020). DL manifestation occurs through different behaviors, which is vital in driving organizations through digital change (Elidjen et al. 2019). A digital leader is a leader with a digital transformation mindset who recognizes and takes advantage of opportunities to make informed and timely leadership decisions for the organization's success (Hai et al. 2021). DL provides a clear vision for the digital process and executes strategies to actualize it (Zeike et al. 2019). DL capabilities enable firms to drive the digital revolution, improving organization performance (Benitez et al. 2022). Finally, in the digital scenario, the overall phenomenon of leadership is changing, as well as the setting in which these behaviors of social influence emerge (Banks et al. 2022).

3 Systematic literature review

3.1 Research method

Systematic literature reviews are "an increasingly used review methodology to synthesize the existing body of literature in a field" (Kraus et al. 2020, p.1023). Typically, this review focuses on a particular topic, while being transparent and reducing bias (Williams et al. 2021). This approach is used to flexibly analyze data to systematically and rigorously integrate, interpret, and synthesize qualitative findings from multiple studies (Finfgeld-Connett 2014).

Our review follows Corley and Gioia (2004) regarding the coding process who structure data according to hierarchical categories such as first-order concepts, second-order themes, and aggregate dimensions. The categories were developed inductively through constant revision of their labels as necessary. The first-order concepts highlight key aspects about the discerned coding process but not the patterns or relationships in the data (Clark et al. 2010). Second-order themes help to assemble a more structured view of the relationships among the first-order concepts by viewing the data at a higher level of theoretical abstraction (Gioia et al. 2010). In the third stage of analysis, major themes are assembled into aggregate dimensions indicate the interrelationships among the major concepts, themes, and dimensions (Gioia et al. 2013). This systematic method leads to a credible interpretation of the data and provides a qualitative rigor to the analysis (Curado et al. 2019; Gioia et al. 2010; Nag and Gioia 2012).

3.2 Data collection

Data were collected from the Web of Science and Scopus (Cobo et al. 2011; Schäfer 2022). First, we performed a search on the terms "e-leadership" or "virtual leadership" or "digital leadership" or "leading online communities" in the Scopus database by focusing on three main subject areas (i.e., social sciences; business, management, and accounting; and psychology) and by using article title, abstract, and keywords for the search. We decided to limit our search to articles published between 2000 and 2020, because Avolio et al. (2000) coined the term e-leadership to connect leadership and technology in 2000. We restricted our search only to journals published in English and eliminated documents such as letters, editorials, conference papers, and book chapters, since these works are a body of certified knowledge providing reliable results (Bhatt et al. 2020; Haleem et al. 2020). The Scopus database had 173 articles and, subsequently, we performed the same search in the Web of Science database to find missing articles. This search turned up 86 articles, most of them overlapped with those from Scopus.

The data retrieved form the bibliographic databases normally contain errors, such as misspelled elements. Consequently, an analysis of the retrieved data was necessary (Cobo et al. 2011). Our exclusion criteria follows Soriano et al. (2018), as articles unrelated to the scope of our research (e.g., articles not related to organizational studies), were excluded. In this way, we excluded thirty-nine articles from non-organizational domain (e.g., educational studies, healthcare topics), three articles that were non-English manuscripts, and sixty-eight in which the search term was missing (e.g., results in the databases provided articles with the word "leadership" instead of "e-leadership"). This process generated 79 articles to be more deeply examined. Appendix A shows the articles belonging to the research dataset and whether they appear in Scopus and/or the Web of Science databases. The decrease in the number of articles from the initial dataset is not unusual, as in Galvagno and Giaccone (2019), Palmaccio et al. (2021), and Keathley-Herring et al. (2016).

3.3 Analysis and results

The aim of data coding is to identify relevant codes or themes in the data without worrying about broader categories (Williams and Shepherd 2017). This study was started by reading all the articles from our selected database with an open mind. We started the first-order codes categorization process by classifying the elements and regrouping them due to their common characteristics (Bardin 2011; Gioia et al. 2012). Sentences were named and assigned to nodes that emerged during the coding process after using an inductive approach with no coding framework in mind (Finfgeld-Connett 2014). A single classification was used for each code that meant the categories were mutually exclusive, as recommended by Weber (1990), to restrict the categories to those codes that unmistakably reflect them and to maximize validity.

As the research progressed, we started seeking similarities and differences among the first-order codes; a process that eventually reduced the number of categories to a more manageable number, namely second-order themes. The first-order concepts and second-order themes were reviewed and renamed, when appropriate. All the articles from the dataset were coded. Finally, we were able to name the aggregate dimensions, building a data structure. The DL capabilities were identified through the second-order themes aggregated into different dimensions. As the search process was based only on leadership keywords concerning digital aspects (i.e., digital leadership, e-leadership, virtual leadership, leading online communities), all the identified capabilities came from articles related to the digital realm.

A qualitative content analysis should be evaluated based on reliability and validity (Duriau et al. 2007). According to Krippendorff (2004), a research procedure is reliable when it replies to the same phenomena in the same way regardless of the circumstances of its implementation. First, stability was achieved when the same content was coded the same way by the same coder (Williams and Shepherd 2017). This process was interactive, with one author constantly going back and forth from the text to the emerging concepts and themes while coding and recoding the data as many times as needed to adequately capture the desired domain. Second, intercoder reliability was achieved when different coders coded the same data the same way (Campbell et al. 2013). Further, the other two authors randomly recoded 10% of the dataset (Potter and Ware 1987; Ader 1995; Potter and Levine-Donnerstein 1999). Agreement among coders was reached through discussion over the coding discrepancies, and intercoder reliability ranged from 92 to 98%. The validity of the findings was evaluated based on data saturation and fit (Finfgeld-Connett 2014). When we finished coding the forty-seventh article, we reached theoretical saturation (Glaser and Strauss 1967). Additional data did not increase understanding or meaning and thus, no new codes arose. Consequently, clear and unambiguous items were developed based on the second-order themes. The use of simple language and short sentences was a concern relating to the creation of items that aimed to be neither double barreled nor leading (Fisher et al. 2001).

The aggregate dimensions and their definitions are detailed in Table 1. Four different dimensions were identified, namely strategic focus, delivery related, personal attribute and interpersonal oriented. Table 2 shows the second-order themes

Table 1 Aggregate dimensions' definitions

Aggregate dimension	Definition
Interpersonal oriented	Interpersonal capability is about interacting successfully with others (Giromini et al. 2016)
Personal attribute	Personal attribute refers how leaders manage themselves by being able to handle their own emotional reactions even in uncertainty and uncomfortable situations (Scott et al. 2008)
Strategic focus	Strategic capabilities refer to how organizational leaders enable the formation and deployment of strategy towards the organization´s future goal (Orndoff 2002)
Delivery related	Delivery related capability is about achieving the desirable outcome by facilitating goal and task accomplishments (Cordery et al. 2009)

identified for each dimension with their definitions. There are 32 constructs in total, being 9 related to strategic focus, 8 for delivery related, 8 for interpersonal oriented, and 7 for personal attribute.

4 Delphi study

4.1 Research method

A Delphi study is a scientific process designed to elicit and organize the opinions of experts to reach consensus (Miller 2001), and to validate the information from the literature (Ahmad and Wong 2019). Therefore, this method requires a panel of experts on the subject under study (Schmidt et al. 2001). One benefit of the panel is that the experts asynchronously participate in group communication and they can be geographically dispersed as they do not meet each other nor interact directly (Linstone and Turoff 2011). The Delphi study can combine academic expertise with practitioners' perspectives that enables each participant to express their views independently while providing information generated by an entire group (Foth et al. 2016). It can obtain a reliable consensus of the panel of experts through systematic interactives approaches, or "rounds", using a questionnaires with controlled feedback (Clayton 1997; Linstone and Turoff 2011). Some authors call it "e-Delphi" when referring to the use of an online platform to administer the questionnaire (Massaroli et al. 2017; Bec et al. 2019). The number of experts (n = 24) recruited in this study was within the scope of the most frequent size in the literature (n = 15–30) (de Jesus et al. 2019). Each expert was required to have leadership experience and to possess specialized knowledge and interest in the studied topic. We drew experts who worked in different countries, such as Portugal, China, France, Germany, Switzerland, and Brazil to obtain a greater diversity in the outcome.

Standard Delphi studies usually have three rounds of data collection (Brady 2015), but some authors argue that the classic technique has four rounds (Hasson et al. 2000). Erffmeyer et al. (1986) argue that before limiting Delphi to less than four rounds, the researcher should confirm if they have reached stability in the

Table 2 Dimensions and second-order themes from the literature

Dimensions	Second-order themes	Definition
Interpersonal oriented	Build and maintain relationships and networks	Constructing and keeping relationships and networks with others
	Build trustworthiness	Being consistent of words and act, and keeping promises to reduce uncertainty in relationships
	Communicate effectively	Express ideas clearly and completely, either orally or in writing, and listening carefully to others
	Able to resolve conflicts	Fostering alignment to resolve conflicts with value-added results
	Empower people	Allowing and encouraging others to improve their own power and autonomy to solve a problem
	Encourage cognitive diversity	Listening and comprehending diverse perspectives with an open mind
	Inspire and engage people	Being a role model and influencing others to commit
	Coach team members	Assisting others in improving their performance
Personal attribute	Curiosity	Interested in understanding new things or clarifying something
	Enthusiastic and passionate	Transferring energy to others and showing passion for work
	Ethical mindset	Showing integrity and honesty in word and action
	Flexibility and adaptability	Adjusting the responses to dynamic and unforeseen circumstances
	Lifelong learning	Learning new things quickly, continually, and thoroughly
	Positive attitude	Having an optimistic mindset that focuses on the good
	Initiative	Acting without needing to be told or persuaded
	Autonomy	Being self-governed without the intervention of others
	Self-awareness	Being able to recognize your own strengths and weakness

Table 2 (continued)

Dimensions	Second-order themes	Definition
Strategic focus	Calculated risk-taking	Assessing the risk of something with the currently available information
	Foresight, facilitate and lead change	Anticipating forthcoming tendencies and acting to rapidly plan and implement them
	Promote innovation	Creating new solutions with imagination and originality
	Incorporate and manage diversity	Integrating and understanding people with different backgrounds (i.e., gender, race, age, cultural etc.)
	Promote knowledge sharing	Stimulating exchange information from one person to another person or group
	Provide vision and direction	Informing the future vision and setting appropriate guidance to the team
	Agility	Responding quickly and effectively to opportunities and threats
	Sustainability acumen	Being social, environmentally, and economically conscious about the organization´s external impact
	Able to identify and retain talent	Bringing capable people into the team and keeping them motivated
Delivery related	Analytical thinking that hold meaning	Extracting key information from data to develop workable solution
	Creative problem solving	Finding new ways to resolve a problem
	Digital and technological savvy	Knowing about digital and new technologies to anticipate the impact on business
	Establish and manage team performance	Setting and orienting team assignments towards the desired outcomes
	Promote collaborative teamwork	Working with others to accomplish tasks that can yield better results
	Provide resources to the team	Providing anything that is needed to execute a task
	Results orientation	Focusing on achieving results that have a positive impact on the organization
	Business skills	Possessing the abilities and knowledge needed to manage a project
	Able to manage work-life balance	Balancing work demands and personal life

previous rounds with an acceptable level of accuracy. Usually, Delphi studies starts with open or semi-open questions to collect data from experts and the next rounds are made up of items generated by experts in the first round combined with items identified from the literature that are aimed at reaching stability and consensus in the next rounds (Dewar et al. 2017).

4.2 Data collection and measurement

Our study consists of four rounds and starts with online interviews using semi-open questions. The next rounds were conducted through an online questionnaire system (www.qualtrics.com) and were based on the responses of the interviewees combined with the data gathered in the literature (Ahmad and Wong 2019). Regarding the available time that experts dedicated to the Delphi study, the experts in Round-02 were separated into two groups receiving different questionnaires due to the large number of items to be evaluated. For Round-02 onwards, the experts had a week to respond, and two reminders were sent per round: the first, 1 day before the deadline; and the second, on the deadline day itself. The expected time for completion for each questionnaire varied from 5 to 15 min. There was an option to give comments in the questionnaire for all rounds. Different measures were used to assess the items across the questionnaire rounds, including picking-type (Round-02) and Likert-type (Round-03 and Round-04). These measures were designed to measure the items from different perspectives and for different purposes to identify the most important ones (Okoli and Pawlowski 2004; Bec et al. 2019). It is essential to differentiate between the concept "consensus" and "stability" in Delphi studies. Stability refers to the consistency of experts' answers between successive rounds of a Delphi study and it is considered a necessary criterion to evaluate consensus (Dajani et al. 1979; Von der Gracht 2012). Although there are different approaches to defining and reporting consensus (von der Gracht 2012), systematic reviews have shown that consensus is mainly defined based on the percentage of experts who rate items at the upper extremes of the Likert scales used (e.g., items scored as 4 and 5 on a 5-point Likert scale) (Diamond et al. 2014; Foth et al. 2016). There is no agreement about the percentage of answers by experts that is considered consensus. Some authors state that items with 50% or more have reached consensus (Trevelyan and Robinson 2015), while others argue that 60% or higher is preferable (Foth et al. 2016). This differentiation is important since stopping a Delphi study based only on a specific number of rounds may lead to invalid and meaningless results (Barrios et al. 2021). Measures of group stability also varies in the literature, varying from a coefficient of variation (CV) of 15% change in two Delphi rounds (Von der Gracht 2012) up to 20% (Massaroli et al. 2017; Shi et al. 2020).

4.3 Delphi rounds

In the first Delphi round, we asked open-ended questions of 24 experts during in-depth on-line interviews that aimed to obtain practical insights about which leadership capabilities they considered to be the most relevant to thrive

in a digital environment. The interviews were composed of open-ended questions (de Jesus et al. 2019), which are acknowledge to increase the richness of the information collected (Powell 2003). All the experts consented to having the interviews recorded as per our protocol (Massaroli et al. 2017). The interview responses were analyzed to compare with the capabilities identified in the systematic literature review, adding the practical insights of the experts concerning DL capabilities.

The qualitative analysis of the first round improved the spectrum of capabilities and provided more themes to be processed in the following rounds, as performed in Ahmad and Wong (2019) and Dewar et al. (2017).

Round-02 involved narrowing down the list of items based on the new capabilities identified by the experts in Round-01, added to the items found in the systematic literature review (Okoli and Pawlowski 2004). Each expert received a unique code that identified them in the questionnaire throughout the rounds. We sought to restrict the number of items in Round-02 to facilitate future consensus (Hsu and Sandford 2007; Schmidt et al. 2001). A list of items was sent to the experts with instructions to indicate those which were most important for the leadership capabilities in the digital environment. The list was randomly ordered to reduce any bias (Paré et al. 2013; Schmidt 1997). We requested that the experts select at least 40% of the items for each dimension they considered the most important for a leader in digital era, as the literature has stated that the experts should independently select at least 10% of the items as the most important (Schmidt 1997). Regarding consensus, we eliminated all items that were not selected by at least 60% of the respondents, following Foth et al. (2016). In addition, if a capability had less than three remaining items, it was eliminated as some authors recommend against retaining constructs with less than three items (Worthington and Whittaker 2006). This process reduced the lists to a manageable size.

In Round-03 and Round-04, the questionnaires were used for the purpose of attaining consensus on items by the panel of experts. Items were measured by using a Likert scale that ranged from 1 (not important) to 5 (very important). The Round-03 questionnaire was developed based on the items retained in Round-02. The items were again randomly presented within each dimension to avoid bias. The consensus on the inclusion of items for the next round was based on their means. The items that scored 4 or 5 on the Likert scale were kept separate as they had already achieved consensus, as suggested by Barrios et al. (2021). Therefore, only the items that received a mean rate of less than 4 were considered for Round-04 to be re-evaluated by the panel of experts. Furthermore, at least three remaining items for each capability should remain to retain the construct, as in the previous round.

For Round-04, to ascertain the level of collective opinion, we attributed the mean scores of the expert's rate for each item that had not obtained consensus to each expert, to remind them of their previous responses (Hasson et al. 2000). Questionnaires were prepared individually for each expert and they were asked to re-consider their rates maintaining or modifying their previous rate (Trevelyan and Robinson 2015). Finally, the items were analyzed to identify consensus. Applying the same criteria used in Round-03, the items with scores of less than 4 had not reached consensus and were eliminated. The experts´ group stability from Round-03 to

Round-04 was 15%, which is in line with Diamond et al. (2014) for the Delphi process to reach stability.

4.4 Analysis and results

While we had 24 experts who participated in the first round, only 16 completed all four rounds. This reduction was is in line with other Delphi studies in which the abstention rates varied from 20 to 50% in each round (Massaroli et al. 2017). Concerning demographic information, the characteristics of the experts in the first round had an average leadership experience (± standard deviation) of 17.0 years ± 5.84 years and all of them had at least a bachelor degree, while 46% had a master´s degree, and 8% had a doctorate. Of the experts, 50% were male and 50% were female. The average age was 45.96 years ± 6.64 years. Moreover, 21% of the experts were between 30 and 40 years, 54% were between 41 and 50 years and 25% were more than 50 years old.

In Round-01, no new dimension was identified through the interview process. The experts identified 11 capabilities: 6 for personal attribute, 3 for interpersonal oriented, 2 for delivery related, and none for the strategic focus dimension. New items were elaborated and added to the initial pool creating the baseline for Round-02. The number of constructs identified, either in the literature review process or by the experts, together with the consensus information for each round are shown in Appendix B regarding all four dimensions.

In Round-02, there were a total of 292 items concerning all four dimensions to be evaluated among the experts. Among these items, 68 belonged to the strategic focus dimension, 68 to delivery related, 80 to personal attribute, and 76 to interpersonal oriented. Each expert judged two dimensions that they received in the questionnaire and could choose a certain number of items. There was between 144 and 148 items for them to select as the most important concerning two dimensions. Some second-order themes were eliminated in this round, as the experts did not choose the correspondent items and, so, the theme did not reach the minimum of three items to be maintained for the next rounds. For the interpersonal dimension, the second-order themes that were eliminated were "able to resolve conflicts" and "willingness to listen"; for strategic focus, the theme was "sustainability acumen"; for personal attribute, they were "humility", "self-awareness", and "self-regulation"; and, for delivery related, they were "creative problem solving", "provide resources to the team", and "able to manage work-life balance".

In Round-03, the quantity of items rated by the experts were 40 strategic focus, 34 delivery related, 52 personal attribute and 32 interpersonal oriented. For each dimension, the number of items that reached consensus in this round were 36 strategic focus, 31 delivery related, 41 personal attribute and 27 interpersonal oriented. In this round, there were some second-order themes for which that all the items reached consensus; consequently, these were designated as final, and the other items were excluded from Round-04.

In Round-04, the number of items that have reached consensus were 2 for strategic focus (out of 4), 2 for delivery related (out of 3), 2 for personal attribute (out of

11) and 2 for interpersonal oriented (out of 5). The second-order themes that were eliminated in the final round were "inspire and engage people" (interpersonal oriented dimension), "curiosity" and "enthusiastic and passionate" (personal attribute dimension) and none for strategic focus and delivery related. In all four dimensions, the change in distribution of the responses was less than 15%. This procedure is a crucial part of the Delphi process in determining consensus and stability in the answers (Shi et al. 2020) and, therefore, the stopping criteria rule was reached. After this fourth round, the remaining capabilities and their definitions can be seen in Table 3.

A conceptual model of the final digital leadership capabilities is presented in Fig. 1. Concerning the four dimensions and the relationship within each theme, an interpersonal oriented leader interacts successfully with others (Giromini et al. 2016). Therefore, this dimension relates to social interaction between leaders and followers, such as establishing relationships, communicating, being trustworthy, coaching, inspiring, empowering, and engaging people (Buchan et al. 2008; Schiuma et al. 2022; Walvoord et al. 2008). The personal attribute dimension informs how leaders manage themselves and their emotional reactions to situations (Scott et al. 2008). This dimension and its constructs concern the leaders' inner self: curiosity, initiative, autonomy, and self-awareness (Owens et al. 2013; Shamim et al. 2016). The strategic focus dimension establishes how leaders form and deploy strategic decisions toward the organization's future goals (Orndoff 2002). Therefore, this dimension refers to leadership capabilities that affect a long-term organizational objective and the response to changes (Vecchiato 2015). Some leadership constructs identified within this dimension are vision and direction, innovation, sustainability, knowledge sharing, and leading change (Kane et al. 2019; Lawrence 2015; Swanson et al. 2020). Lastly, the delivery related dimension refers to the leadership capability of managing the team toward a desired outcome (Cordery et al. 2009), and the leadership capabilities for this dimension include results orientation, creative problem solving, and establishing and managing team performance (Agarwal et al. 2017; Taggar 2001).

Following Cronin and George (2023), it is indicated in the conceptual model three different categories (literature, *experts*, literature/experts). It is informed if a construct was, proportionally (i.e., difference in percentage of the number of times the construct appeared in the literature compared to the number of times the experts mentioned it), more heavily based on articles from the research dataset (literature) or deriving more from the experts' assessment, or if the construct was balanced reported between the literature information and experts opinion (i.e., difference less than 10% between the literature and the experts).

5 Discussion

Our findings are in line with Kane et al. (2019), as while many core leadership capabilities remain the same, the unique demands of the digital environment require new capabilities as well. A big danger is to disregard the essentials of good leadership due to digital change. It seems the difference between e-leadership and digital

Table 3 Remaining dimensions at the end of Round-04

Dimensions	Capabilities	Definition
Interpersonal oriented	Build and maintain relationships and networks	Constructing and keeping relationships and networks with others
	Build trustworthiness	Being consistent in words and acts, and keeping promises to reduce uncertainty in relationships
	Communicate effectively	Express ideas clearly and complete, either orally or in writing, and listening carefully to others
	Empower people	Allowing and encouraging others to improve their own power and autonomy to solve a problem
	Encourage cognitive diversity	Allowing and encouraging others to improve their own power and autonomy to solve a problem
	Coach team members	Assisting others in improving their performance
	Promote psychological safety	Feeling comfortable in expressing ideas and disagreements without fear of retaliation
Strategic focus	Calculated risk-taking	Assessing the risk on something with the currently available information
	Foresight, facilitate and lead change	Anticipating forthcoming tendencies and acting to rapidly plan and implement them
	Promote innovation	Creating new solutions with imagination and originality
	Incorporate and manage diversity	Integrating and understanding people with different backgrounds (i.e., gender, race, age, cultural, sexual orientation etc.)
	Promote knowledge sharing	Stimulating exchange information from one person to another person or group
	Provide vision and direction	Informing the future vision and setting appropriate guidance to the team
	Agility	Responding quickly and effectively to opportunities and threats
	Able to identify and retain talent	Bringing capable people into the team and keeping them motivated
Personal attribute	Ethical mindset	Showing integrity and honesty in word and action
	Flexibility and adaptability	Adjusting the responses to dynamic and unforeseen circumstances
	Lifelong learning	Learning new things quickly, continually and thoroughly
	Positive attitude	Having an optimistic mindset that focuses on the good
	Initiative	Acting without needing to be told or persuaded
	Autonomy	Being self-governed, without the intervention of others
	Empathy	Putting yourself in the shoes of others, feeling sympathy for other´s emotions and perspectives

Table 3 (continued)

Dimensions	Capabilities	Definition
Delivery related	Analytical thinking that hold meaning	Extracting key information from data to develop workable solution
	Digital and technological savvy	Knowing about digital and new technologies to anticipate the impact on business
	Establish and manage team performance	Setting and orienting team assignments towards the desired outcomes
	Promote collaborative teamwork	Working with others to accomplish tasks that can yield better results
	Results orientation	Focusing on achieving results that have a positive impact on the organization
	Business skills	Possessing the abilities and knowledge needed to manage a project
	Time management	Being able to plan and manage the time among assignments

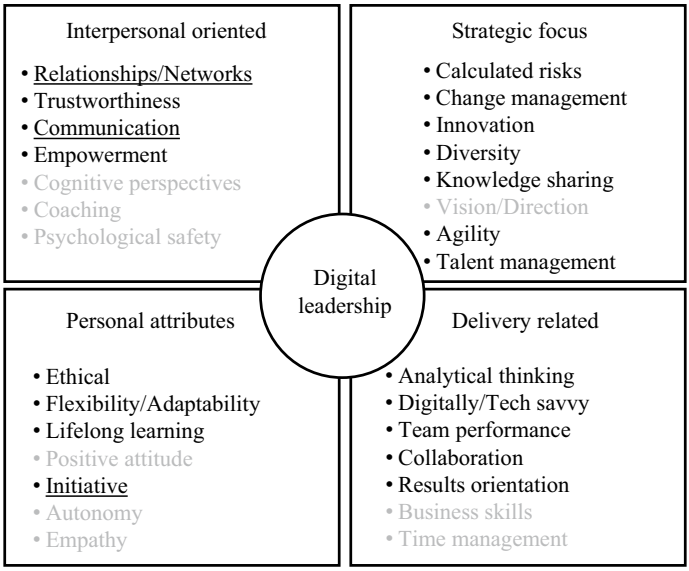

Fig. 1 Conceptual model of the digital leadership capabilities. Literature; Experts; Literature/Experts

leadership is that the latter is not only mediated by technology, but it is a way of thinking and behaving in a complex time (Tigre et al. 2023).

Concerning integrating the literature review and the Delphi survey, some constructs seemed to receive greater emphasis from experts than others compared to the literature. It seems particularly relevant for leaders in the digital world to provide a psychological safety environment, obtain different cognitive perspectives, and coach the team. The reason may be that in a fast-changing and complex world, the leader must create an environment where the team has a shared belief that it is safe for interpersonal risk taking (e.g., expressing opinions without fearing punishment) (Edmondson 1999). From a practical standpoint, psychological safety is a timely topic given the growth of the knowledge economy and teamwork, in which employees are expected to integrate perspectives, share information and ideas, and work together to achieve common goals (Edmondson and Lei 2014). In addition, the leader needs to incorporate diversity in the team to solve a complex problem, as it is crucial to consider the different cognitive aspects simultaneously (Wang et al. 2016). Such leaders also engage in coaching, creating new learning opportunities, and value diversity in their followers (Oke et al. 2009).

Furthermore, cognitive perspectives, psychological safety, positive attitude, and empathy are more heavily based on the experts´ opinion. Diversity management is a process intended to create and maintain a positive work environment where the similarities and differences of individuals are valued to maximize their contributions to the organization goals (Hayes et al. 2020). The digital scenario also provides more flexibility regarding working time and place, therefore more autonomy for workers (Ruiner and Klumpp 2022), which was also highlighted in the experts' choice compared to the literature.

Other topics such as providing vision and direction, time management, and business skills are long-standing traditional components of leadership that were distinguished from the experts compared to the literature. Nonetheless, the experts are in line with the survey regarding more than 20,000 leaders performed by Kane et al. (2019) that state that in a digital scenario, with an emphasis on future change, the most critical leadership capability to possess in a digital organization is a transformative vision to provide direction. This vision includes the ability to anticipate markets and trends, make savvy business decisions, and solve challenging problems in turbulent times. The results of Kane's survey also stated that leaders need business skills to manage the business trends that change due to technology and to guide the organization in response to them (Kane et al. 2019). Finally, the importance of time management in digital times highlighted by the experts is in line with a review that informed the implementation of time management in practice is justified by having favorable effects on people's perceptions and feelings (Claessens et al. 2007).

The digital era has led to some leadership paradoxes as technology may affect the way leadership is done. Leaders need to give their teams autonomy but without them feeling isolated; to preserve focus and purpose in an fast-changing environment requiring profound flexibility and adaptability; and, to harmonize efficient well-known responses with fresh insights and innovation (Pulley et al. 2002). Due to a more connected world where people can be reached almost anywhere, leaders need to build and sustain relationships and networks inside and outside of their organizations (Kissler 2001; Cordery et al. 2009). The quality of relationships and networks that leaders and team members form in their organizational environment is also known as "social capital" (Zaccaro and Bader 2003). Moreover, there has been a change in relationships between leaders and their followers. Leadership is moving from authority driven to network relationships that result in reciprocal benefits for the parts involved. The effect of network collaboration can reach more favorable results if each individual can have a network outside the organization they work (Pulley and Sessa 2001).

A paramount aspect for leaders in any team is to build trustworthiness, as it can affect the overall productivity of the group (Tigre et al. 2022). Trust is established by repeatedly setting expectations and then delivering results that meet or exceed those expectations (Cascio and Shurygailo 2003). Nonetheless, in a virtual environment, special attention should be given to the groups of team members that work separated from each other. In this environment, people usually do not have the opportunity to establish trust to the same level as if they work at the same physical location (Anoye and Kouamé 2018). One major challenge within any teamwork is effective communication. Leaders should encourage people to talk and listen to them, while motivating nonparticipative members to express their point of view (Cordery et al. 2009) and by having frequent communication to avoid misinterpretation (Avolio and Kahai 2003). Zaccaro and Bader (2003) find that the leader´s role is to motivate and empower team members with the aim of devoting more effort to team tasks. More than ever before, digital technology enables people from any organizational level—and even beyond the organization—to participate and to be heard. Finally, leaders must coach team members for professional improvement (Cordery et al. 2009).

Providing team members with a clear vision and direction in times of uncertainty, is a capability that is desirable for digital leaders. The leader ensures the team actions are aligned with the organizational purpose (Avolio et al. 2000). Besides having a strong vision, leaders need to foresee changes and promote innovation, aside from facilitating and leading change. The ability to assist change in facing digital and business opportunities helps employees feel a part of the bigger picture and to become engaged. Leaders should be value creators and protectors for their organizations (Li et al. 2016). Quick responses to opportunities and to threats—being agile -, a buzz word often used in the digital realm—are valuable to all leaders who want to succeed in uncertain times (Pulley and Sessa 2001). Agile organizations continually evolve and are flexible enough to adapt themselves to a constant changing environment (Pulley and Sessa 2001). Incorporating diversity in all forms (e.g. cognitive, ethnic, gender, and age) helps drive innovation in the organizations that improves their overall effectiveness (Pulley et al. 2002; Li et al. 2016) and stimulates their knowledge sharing that breaks down reticence from culturally diverse members and improves collaboration (Cordery et al. 2009). Calculated risk-taking (Kissler 2001) and informed decision-making (Van Wart et al. 2017b) in fast-paced times are essential to digital leaders. Many leaders do not have the answers to the problems they face. Because of the increasing complexity, volatility, and ambiguity of digital problems, encouraging cognitive diversity is a valuable resource. No single point-of-view holds the only truth (Pulley and Sessa 2001) and a psychological safe environment is needed for people to be confident that their inputs are welcome and appreciated (Cordery et al. 2009). Further, in order to have a competitive team, leaders must be able to identify and retain talent, by quickly screening and selecting candidates expected to rapidly create value for the organization (Kissler 2001; Belitski and Liversage 2019).

The fast-changing ways in which digital technologies are being implemented means that leadership ethics become even more important than ever before. It is mandatory to care about ethical leadership behavior to discern moral dilemmas, prioritize values, evaluate risks, protect privacy, and make ethical decisions (Lee 2009). Leaders in the digital age should think outside the box and to envisage new scenarios for digital business across firms and industries; therefore, an open mind is particularly necessary (Li et al. 2016). The leader's positive attitude has an impact on the team that can increase their productivity. Initiative is also an important factor that can enable a quick response to the main threats to competitiveness in the digital age (Cascio and Shurygailo 2003). Organizations around the globe are experimenting and innovating every day. Thus, to meet the needs of this evolving market, leaders need to be an insatiable lifelong independent learner (Kissler 2001). This constant changing environment requires initiative and empathy to cope with stressful situations or crises as well as being enthusiastic and passionate about things (Li et al. 2016).

Organizations need leaders who understand and are better prepared for the impact that digital technology can have on their business. Digitally savvy leaders are better prepared to face constant business challenges, anticipating and responding to new forms of competition, coping with complexity and leveraging data and analytics to make decisions that rely on a hands-on approach (Belitski and Liversage 2019; Van

Wart et al. 2017a). Leaders need to have analytical thinking to meaningfully interpret the vast amount of data that has never been greater (Pulley and Sessa 2001; Pulley et al. 2002). Besides being digitally savvy, leaders also need to have business skills, such as administrative and industry knowledge but also be aware of time management to work in a fast-changing environment (Zaccaro and Bader 2003). Finally, being result orientated towards an issue is also a desirable capability for a digital leader. Leaders are expected to maintain the high performance of their team by establishing performance goals, helping develop workable plans, and by providing results (Zaccaro and Bader 2003).

The literature review in this study considers articles published until year 2020. Nonetheless, we analyzed new data collection from Scopus and Web of Science databases between years 2021 and 2022 to update the literature review to verify if any relevant DL capabilities appeared more recently. Again, the exact keyword search and exclusion criteria were applied. The new search result in a dataset containing 138 articles, in which 42 articles were excluded from the analysis due to non-organizational issues, resulting in 96 articles. Appendix C shows the articles concerning the years 2021 and 2022.

The findings show an increase in articles concerning the DL aspect. This result is in line with the bibliometric analysis of Tigre et al. (2023), which concludes that the DL field has not entered its maturity stage yet, stating the relevance and actuality of the theme. Moreover, the body of literature that recognizes the key aspect of DL is growing (Wang et al. 2022). The COVID-19 pandemic and technological advancement seem to channel the DL theme (Aggarwal and Kumar 2022). Therefore, the COVID-19 crisis emphasized leadership in the face of uncertainty and stress (Sandberg et al. 2022). The relevance of understanding which behaviors improve social interactions and organizational performances in digital scenarios remains critical, especially after the COVID-19 advent (Bellis et al. 2022).

The literature review of this new dataset seems to reinforce the capabilities of DL captured by the content analysis conducted from the year 2000 to 2020, reinforced by the Delphi panel. In addition, it seems to be an emphasis in the digital transformation economy on understanding how to create renewed leadership capabilities to lead a workforce transformation while creating market value (Jackson and Dunn-Jensen 2021).

Some studies focus on some critical DL capabilities to drive digital transformation: digital literacy, positive attitude, knowledge sharing, engagement, trust, and ethics (Abbu et al. 2022). Different leadership capabilities are also examined (e.g., results of information dissemination, goals and assessments, mistakes and conflicts, change, and innovation) (Harbani et al. 2021). Bibliometric and content analysis is the focus of a different study that identifies three clusters of e-leadership in a virtual environment: virtual leadership and virtual team performance, adoption of technology, and e-communication strategies (Aggarwal and Kumar 2022). Moreover, a different study focuses on six leadership capabilities for digital transformation entrepreneurship (e.g., knowledge creation, communication, engaging people, mentoring, envisioning digital changes, promoting digital transformation) (Schiuma et al. 2022). Finally, some authors categorize the effectiveness of complementary leadership behaviors in the digital age, namely task-oriented (i.e., providing direction, control

of work) and people-oriented behaviors (i.e., establishing trustful relationships, providing support to employees) (Weber et al. 2022). It seems that different DL capabilities are necessary to thrive in the digital scenario. However, how the capabilities are studied separately or integrated into different categories or dimensions may vary significantly.

Leadership is also studied concerning the gig economy workers (i.e., individuals acting as freelancers for organizations) through virtual environments that impact how leadership unfolds (Nieken 2022; Schmidt and Van Dellen 2022). Other study uses a systematic literature review of how human relationships change in a digital scenario and what to expect for the post-pandemic (Bellis et al. 2022).

Nonetheless, some articles focus on some specific DL capabilities. Innovation is a topic that appears in many studies (e.g., Erhan et al. 2022; Wang et al. 2022), informing that DL influences innovation performance to explore and exploit the benefits of digital transformation (Benitez et al. 2022). Creativity is another topic that continues to appear in academic studies. DL positively affects employee creativity, demonstrating the relationship between these constructs (Zhu et al. 2022). Furthermore, DL should focus on trust for organizations to thrive in the rapidly changing innovation environment (Abbu et al. 2022). Leading virtual teams is a leadership concern around trust, communication, engagement, and support (Wittmer and Hopkins 2022). Finally, different aspects of collaboration (Komp et al. 2022), sustainability (Niu et al. 2022), and autonomy (Ruiner and Klumpp 2022) also appear.

Therefore, our proposed framework that integrates essential DL capabilities in four dimensions seems to be updated concerning the academic literature post-COVID pandemic.

5.1 Limitations

While our review is timely and includes both an academic literature analysis and a practitioner perspective, it is not without its limitations. The background of each panel member may directly influence their decision-making about the topics; this bias is generally not within the control of a Delphi study. Additionally, panel members are often limited in the amount of time they could dedicate to the Delphi study, therefore reducing their ability to consider all dimensions under study. Although the results from a panel of experts can produce practical and thoughtful insights, they may not be an exhaustive nor an all-inclusive set of ideas. Regarding the systematic literature review, despite analyzing 21-years of peer-reviewed articles, the choice to limit the study to those that explicitly mentioned the search terms and may have missed some important articles concerning the theme.

5.2 Future research

The avenues for future research are plentiful. Upcoming literature reviews and Delphi studies should consider expanding the keywords for different searches on the digital phenomena. Focusing on digital technologies (e.g., artificial intelligence, machine learning) could provide some new insights for the field, and new leadership

characteristics can emerge as the topic becomes more mature in organizations and the literature. Furthermore, it will be necessary to empirically validate the proposed capabilities through new and different studies. Nonetheless, this study can be regarded as an insight into the main leadership capabilities for digital times. Other future studies could strengthen the studies on the competencies that were highlighted most strongly by the experts compared to the literature. Perhaps these topics have nuances to better explore due to the digital transformation.

DL operationalization could be established by elaborating a scale to measure the DL capabilities expected of the digital leader. Table 4 suggests items that could be tested using an exploratory factor analysis followed by a confirmatory factor analysis to verify which items will remain in the final DL scale. Moreover, a causal relationship between different DL constructs could be explored. As leadership is context-related, what are the most significant changes in DL behaviors pre- and post-COVID-19? How important is each dimension concerning the industry of DL studied? Is there any difference?

Leadership is context-related (Osborn et al. 2002). Therefore, the DL needs to perform in a time of disruptive technological change, in which strategic importance of ethics in the context of DL is important (Vial 2019). With the increased use of generative AI systems (e.g., ChatGPT) to provide content or outputs (e.g., text, images, audio, etc.) based on the data they are trained on (Eke 2023), DL is needed to operate and guide the organization towards an acceptable and ethical behavior using these systems (Dwivedi et al. 2023). AI has been used to accomplish different HR activities (e.g., recruitment, selection, training) in organizations (Banks et al. 2022). AI relies on data, training models, and human input, being possible to inject bias into the system (Dwivedi et al. 2023). Therefore, another study could concentrate on the DL role to avoid bias amplification and to ensure diverse representation (e.g., see Bolukbasi et al. 2016 as an example of gender bias in machine learning datasets). As more machine-based human interactions are being used as recruiters (e.g., AI chatbots), the findings may have implications for identifying the impact on HR recruiting and engagement practices (Nawaz and Gomes 2019). Therefore, calling leaders to concentrate their attention on it. Another future study can combine case studies and in-depth interviews to understand of employees' AI usage contribute to employee performance and engagement (Wijayati et al. 2022) and how DL influences employees' behavior. In addition, the qualitative examination could provide different elements of the DL's capabilities. Finally, leaders must increasingly interact between employees and AI, adding another component to the leadership process (Peifer et al. 2022).

While Industry 4.0 is about automation (i.e., AI, machine learning, big data), Industry 5.0 focuses on the synergy between humans and autonomous machines (Nahavandi 2019). The introduction of robots in the workplace may affect social interactions and can be more challenging with robots in management or superior positions (Demir et al. 2019). Therefore, another potential study could examine the leader–follower interaction when one part is a robot. How different will the employee's social behavior be in interaction with human leaders and robot leaders, if any? What are the challenges for managers to build a team based on collaboration, having humans and robots working together?

Table 4 Proposed dimensions and items

Dimensions	Capabilities	Items
Interpersonal oriented	To build and maintain relationships and networks (constructing and keeping relationships and networks with others)	I am friendly and make a connection with people around me
	To build trustworthiness (being consistent in words and acts, and keeping promises to reduce uncertainty in relationships)	I am honest in dealing with my team
	To communicate effectively (express ideas clearly and completely, either orally or in writing, and listening carefully to others)	I listen to what my team has to say
	To empower people (allowing and encouraging others to improve their own power and autonomy to solve a problem)	I convey that my team take responsibility for their job
	To encourage cognitive diversity (listening and comprehending diverse perspectives with an open mind)	I establish a psychological safety environment for my team to express different perspectives and ideas
	To coach team members (assisting others in improving their performance)	I help my team to further develop themselves
	To promote psychological safety (feeling comfortable expressing ideas and disagreements without fear of retaliation)	I feel safe to admit when I make a mistake
Personal attributes	To have an ethical mindset (showing integrity and honesty in word and action)	I give an example of doing tasks in an ethical manner
	To show flexibility and adaptability (adjusting the responses to dynamic and unforeseen circumstances)	I am open to new ideas
	To engage in lifelong learning (learning new things quickly, continually, and thoroughly)	I enjoy learning new information
	To have a positive attitude (having an optimistic mindset that focuses on the good)	I keep a positive attitude with my team
	To have initiative (acting without needing to be told or persuaded)	I take the initiative to make things happen
	To have autonomy (being self-governed, without the intervention of others)	I have freedom to do my work as I think is appropriate to perform well
	To have empathy (putting yourself in the shoes of others, feeling sympathy for other´s emotions and perspectives)	I can place myself in another´s position

Table 4 (continued)

Dimensions	Capabilities	Items
Strategic focus	To take calculated risks (assessing the risk of something with the currently available information)	I am confident in taking calculated risks
	To foresee, facilitate and lead change (anticipating forthcoming tendencies and acting to rapidly plan and implement them)	I anticipate and plan for changing situations
	To promote innovation (creating new solutions with imagination and originality)	I offer new approaches to problems
	To incorporate and manage diversity (integrating and understanding people with different backgrounds (i.e., gender, race, age, cultural, sexual orientation etc.)	I consider diversity good for the organization even if it means that I will have a superior who is a minority
	To promote knowledge sharing (stimulating exchange information from one person to another person or group)	I encourage my team to share their knowledge
	To provide vision and direction (informing the future vision and setting appropriate guidance to the team)	I clearly communicate the goals and vision of the organization to my team
	To show agility (responding quickly and effectively to opportunities and threats)	I can quickly respond to changes in the business environment
	To be able to identify and retain talent (bringing capable people into the team and keeping them motivated)	I bring competent people into the team

Table 4 (continued)

Dimensions	Capabilities	Items
Delivery related	To have analytical thinking that hold meaning (extracting key information from data to develop workable solution)	I can identify from a group of information the core issue in any situation
	To be digitally and technologically savvy (knowing about digital and new technologies to anticipate the impact on business)	I can quickly scan the digital realm for new technologies to anticipate their impact on the business
	To establish and manage team performance (setting and orienting team assignments towards the desired outcomes)	I set priorities and tackles assignments accordingly to my team
	To promote collaborative teamwork (working with others to accomplish tasks that can yield better results)	I establish an atmosphere of team cooperation over competition
	To have a results orientation (focusing on achieving results that have a positive impact on the organization)	I encourage my team to work towards goal attainment
	To have business skills (possessing the abilities and knowledge needed to manage a project)	I demonstrate mastery of business skills necessary to the job
	To practice time management (being able to plan and manage the time among assignments)	I am able to prioritize my tasks to resolve them on time

Furthermore, another future study could analyze the interaction between leaders and followers in the metaverse ecosystem using avatars. The metaverse with different design elements is recognized as a valuable means to deliver emotional content and can elicit distinct emotions in people (Dozio et al. 2022). So, how does a leader build trustworthiness with their followers in a different scenario? As leadership is context-related, are there any differences between building trustworthiness in the metaverse and in person?

6 Conclusions

The establishment of an international panel together with a 21-year systematic literature review of leadership in the digital environment allowed us to identify the main capabilities that leaders need to thrive nowadays. The results of our study show that the leadership capabilities have some fundamentals of good leadership mixed with digital tendencies due to the fast-changing business environment, aligned with Kane et al. (2019). Leaders must manage the dynamic capabilities of the organization while seeking market trends to thrive in an unpredictable business era. Although some leadership capabilities are highlighted due to digital transformation, such as to be digital and technological savvy, some of them remain the same, such as to have vision and direction, and to empower the team (Kane et al. 2019).

DL differs from other similar constructs, such as e-leadership and virtual leadership. E-leadership was stated in 2000 due to the growth in information technology (e.g., internet, email, and videoconference) that transformed work and leadership (Avolio et al. 2014). The difference between e-leadership and DL are that the latter is not only mediated by technology (Avolio et al. 2000) but has evolved into a way of thinking and behaving in digital environment (Kane et al. 2019). It seems that leadership effectiveness through virtuality was a significant concern until digital technologies became more present in organizations (Ziek and Smulowitz 2014).

Our findings concerning DL capabilities are in line with other studies (e.g., Kane et al. 2019), as while many leadership capabilities remain the same, the characteristics of digital transformation also require new capabilities. For example, leading networks instead of via hierarchy seems more critical due to improving fast and collaborative work, removing barriers, and increasing agility (Kane et al. 2019). Innovation and adaptability are topics that have strongly appeared more recently, as organizations need to change continuously and rapidly to thrive in a digital world (Tigre et al. 2023). DL drives innovation throughout the organization as a competitive advantage (El Sawy et al. 2016). Digital leaders must have a change-oriented mindset, allowing their followers to try new things, make mistakes, adjust, and scale (Kane et al. 2019). Nonetheless, the fundamental capabilities usually related to leadership (e.g., communication, direction-setting) continue to apply, although they are changing (Pulley et al. 2002). However, traditional leadership capabilities do not simply have to be replaced, but the understanding of leadership acting in the digital

age has to be developed (Jäckli and Meier 2020). The DL needs to anticipate trends and deal with complex problems arising due to digital technology while leading the followers in response to those changes (Kane et al. 2019).

DL is an important construct, as work has been enhanced due to rapid technological advances (Larson and DeChurch 2020). Companies need leadership capabilities to envision and drive digital transformation (Zeike et al. 2019). Since digital technologies are deeply changing how organizations operate, leaders need to develop their skills to be prepared to face the nowadays business scenario (Hai et al. 2021). Therefore, DL holds the possibility to address the business transformation addressed by digital technology (Banks et al. 2022). Against this backdrop, leadership capabilities are the ways in which managers are driving change (Zeike et al. 2019). Finally, DL will be a regular standard element of a digital society (Peng 2021). So, leadership scholars must examine the digital implications for the organizational settings (Larson and DeChurch 2020).

A content analysis is a flexible method that can be used to conduct qualitative systematic reviews (Finfgeld-Connett 2014) and has the ability to capture the richer sense of concepts due to its qualitative basis (Insch et al. 1997). Our study explored the academic literature and developed an inductive approach to address the main capabilities that are needed to excel in a digital world. The four-round Delphi study showed high homogeneity in terms of experts' opinions of the second-order themes. The experts worked in six different countries (Portugal, China, France, Germany, Switzerland, and Brazil) that gave a broader perspective on the topic studied. The result of this work offers insights into the practical capabilities of leadership. This study proposes four dimensions of digital leadership: interpersonal oriented, personal attributes, strategic focus, and delivery related. Additionally, it offered a total of 29 leadership capabilities, with a balanced number for each dimension: 7 interpersonal oriented capabilities, 7 personal attributes capabilities, 8 strategic focus capabilities, and 7 delivery related capabilities. Consequently, we suggest a new scale using a single item to represent each capability (Table 4).

This paper contributes to the literature by presenting a comprehensive analysis of the rising field of leadership in the digital environment by highlighting the differences in the concepts of e-leadership and digital leadership. Moreover, this study provides a broad and holistic perspective on the digital leadership capabilities that has not been previously offered in the literature, while helping practitioners to focus on developing these capabilities.

Appendix A

See Table 5.

Table 5 Articles in the Research Dataset

ID	Article	Dataset
1	Amit, K., Riss, I., and Popper, M. (2016). The role of leadership in the migration decision-making process. *Journal of Immigrant & Refugee Studies*, *14*(4), 371–389	S
2	Angelo, R., and McCarthy, R. (2020). A pedagogy to develop effective virtual teams. *Journal of Computer Information Systems*, 1–8	S
3	Anoye, A. B., & Kouamé, J. S. (2018). Leadership challenges in virtual team environment. *International Journal of Scientific & Technology Research*, *7*(7), 160–167	S
4	Avolio, B. J., & Kahai, S. S. (2003). Adding the "e" to e-leadership: How it may impact your leadership. Organizational Dynamics, 31(4), 325–338	S
5	Avolio, B. J., Kahai, S., & Dodge, G. E. (2000). E-leadership: implications for theory, research, and practice. *The Leadership Quarterly*, 11(4), 615–668	S
6	Avolio, B. J., Sosik, J. J., Kahai, S. S., & Baker, B. (2014). E-leadership: Re-examining transformations in leadership source and transmission. *The Leadership Quarterly*, *25*(1), 105–131	W
7	Banerjee, P., & Chau, P. Y. K. (2004). An evaluative framework for analysing e-government convergence capability in developing countries. *Electronic Government*, *1*(1), 29–48	S
8	Belitski, M., & Liversage, B. (2019). E-Leadership in small and medium-sized enterprises in the developing world. *Technology Innovation Management Review*, *9*(1), 64–74	W
9	Boje, D. M., & Rhodes, C. (2005). The virtual leader construct: the mass mediatization and simulation of transformational leadership. *Leadership*, *1*(4), 407–428	S/W
10	Braun, S., Bark, A. H., Kirchner, A., Stegmann, S., & Van Dick, R. (2019). Emails from the boss—curse or blessing? relations between communication channels, leader evaluation, and employees' attitudes. *International Journal of Business Communication*, *56*(1), 50–81	S/W
11	Campion, L. L., & Campion, E. D. (2020). Leading matters: Take it from the professionals — a high-level overview of virtual leadership according to educational technology scholars (and a few others). *Tech Trends*, *64*(1), 182–184	S
12	Camps, T. W. A. (2009). Two images of the future: Virtual leadership and leadership in organisation. *Journal of Chain and Network Science*, *9*(1), 1–7	S
13	Cascio, W. F., & Shurygailo, S. (2003). E-leadership and virtual teams. *Organizational Dynamics*, *31*(4), 362–376	S/W
14	Cordery, J., Soo, C., Kirman, B., Rosen, B., & Mathieu, J. (2009). Leading parallel global virtual teams: Lessons from Alcoa. *Organizational Dynamics*, *38*(3), 204–216	W
15	Cortellazzo, L., Bruni, E., & Zampieri, R. (2019). The role of leadership in a digitalized world: A review. *Frontiers in Psychology*, *10*, 1–21	S
16	Darics, E. (2020). E-leadership or " how to be boss in instant messaging ?" The role of nonverbal communication. *International Journal of Business Communication*, *57*(1), 3–29	S/W
17	De Paoli, D., & Ropo, A. (2015). Open plan offices—the response to leadership challenges of virtual project work? *Journal of Corporate Real State*, *17*(1), 63–74	S/W
18	Doghri, S. B. S., Horchani, S. C., & Mouelhi, M. (2020). The e-leadership linking inter-organizational collaboration and ambidextrous innovation. *International Journal of Innovation Management*, *2,150,043*	S
19	El Sawy, O. A., Amsinck, H., Kraemmergaard, P., & Vinther, A. L. (2016). How LEGO built the foundations and enterprise capabilities for digital leadership. *MIS Quarterly Executive*, *15*(2), 141–166	W

Table 5 (continued)

ID	Article	Dataset
20	Elidjen, Mihardjo, L. W. W., & Rukmana, R. A. N. (2019). Intervening role of innovation management on relationship between digital leadership and dynamic capability accelerated by collaboration. *International Journal of Innovation, Creativity and Change*, *6*(1), 249–264	S
21	Fernandez, D. B., & Jawadi, N. (2015). Virtual R&D project teams: From e-leadership to performance. *The Journal of Applied Businesss Research*, *31*(5), 1693–1709	S
22	Gerth, A. B., & Peppard, J. (2016). The dynamics of CIO derailment: How CIOs come undone and how to avoid it. *Business Horizons*, *59*(1), 61–70	S/W
23	Gierlich-Joas, M., Hess, T., & Neuburger, R. (2020). More self-organization, more control -or even both? Inverse transparency as a digital leadership concept. *Business Research*, *13*(3), 921–947	S
24	Gleave, T., & Al-Hawamdeh, S. (2002). Knowledge economy and the digital divide in Asia. *Journal of Information & Knowledge Management*, *1*(1), 7–15	S
25	Hambley, L. A., O'Neill, T. A., & Kline, T. J. B. (2007). Virtual team leadership: The effects of leadership style and communication medium on team interaction styles and outcomes. *Organizational Behavior and Human Decision Processes*, *103*(1), 1–20	S/W
26	Holland, J. B., Malvey, D., & Fottler, M. D. (2009). Health care globalization: A need for virtual leadership. *The Health Care Manager*, *28*(2), 117–123	S
27	Hunsaker, P. L., & Hunsaker, J. S. (2008). Virtual teams: A leader´s guide. *Team Performance Management*, *14*(1/2), 86–101	S
28	Iannotta, M., Meret, C., & Marchetti, G. (2020). Defining leadership in smart working contexts: A concept synthesis. *Frontiers in Psychology*, *11*, 1–11	S/W
29	İnel, M. N. (2019). An empirical study on measurement of efficiency of digital transformation by using data envelopment analysis. *Management Science Letters*, *9*(4), 549–556	S
30	Jäckli, U., & Meier, C. (2020). Leadership in the digital age: its dimensions and actual state in Swiss companies. *International Journal of Management and Enterprise Development*, *19*(4), 293–312	S
31	Jawadi, N., Daassi, M., Favier, M., & Kalika, M. (2013). Relationship building in virtual teams: A leadership behavioral complexity perspective. *Human Systems Management*, *32*(3), 199–211	S
32	Jiang, H., Luo, Y., & Kulemeka, O. (2017). Strategic social media use in public relations: Professionals' perceived social media impact, leadership behaviors, and work-life conflict. *International Journal of Strategic Communication*, *11*(1), 18–41	S
33	Johnson, S. L., Safadi, H., & Faraj, S. (2015). The emergence of online community leadership. *Information Systems Research*, *26*(1), 165–187	S
34	Kane, G. C., Phillips, A. N., Copulsky, J., & Andrus, G. (2019). How digital leadership is(n't) different. *MIT Sloan Management Review*, *60*(3), 34–39	S/W
35	Kissler, G. D. (2001). E-leadership. *Organizational Dynamics*, *30*(2), 121–133	S/W
36	Larson, L., & DeChurch, L. A. (2020). Leading teams in the digital age: four perspectives on technology and what they mean for leading teams. *The Leadership Quarterly*, *31*(1), 1–18	S
37	Leduc, S., Guilbert, L., & Vallery, G. (2015). Impact of ICTs on leadership practices: Representations and actions. *Leadership & Organization Development Journal*, *36*(4), 380–395	S/W
38	Lee, M. R. (2009). E-ethical leadership for virtual project teams. *International Journal of Project Management*, *27*(5), 456–463	S/W

Table 5 (continued)

ID	Article	Dataset
39	Li, W., Liu, K., Belitski, M., Ghobadian, A., & O´Regan, N. (2016). E-leadership through strategic alignment: An empirical study of small -an medium- sized enterprises in the digital age. *Journal of Information Technology*, *31*, 185–206	S/W
40	Liang, T. Y. (2007). The new intelligence leadership strategy for iCAS. *Human Systems Management*, *26*(2), 111–122	S
41	Liao, C. (2017). Leadership in virtual teams: a multilevel perspective. *Human Resource Management Review*, *27*(4), 648–659	S/W
42	Liu, C., Ready, D., Roman, A., Van Wart, M., Wang, X. H., McCarthy, A., & Kim, S. (2018). E-leadership: an empirical study of organizational leaders' virtual communication adoption. *Leadership and Organization Development Journal*, *39*(7), 826–843	S/W
43	Liu, C., Van Wart, M., Kim, S., Wang, X., Mccarthy, A., & Ready, D. (2020). The effects of national cultures on two technologically advanced countries: The case of e-leadership in South Korea and the United. *Australian Journal of Public Administration*, *79*(3), 298–329	S/W
44	Lu, L., Shen, C., & Williams, D. (2014). Friending your way up the ladder: Connecting massive multiplayer online game behaviors with offline leadership. *Computers in Human Behavior*, *35*, 54–60	S/W
45	Maduka, N. S., Edwards, H., David, G., Osborne, A., & Babatunde, S. O. (2018). Analysis of competencies for effective virtual team leadership in building successful organisations. *Benchmarking: An International Journal*	S/W
46	Meghana, J., & Vijaya, R. (2019). E-leadership, psychological contract and real-time performance management: remotely working professionals. *SCMS Journal of Indian Management*, *16*(3), 101–111	S
47	Mihardjo, L. W. W., Sasmoko, Alamsyah, F., & Elidjen, E. (2019a). Digital leadership impacts on developing dynamic capability and strategic alliance based on market orientation. *Polish Journal of Management Studies*, *19*(2), 285–297	S/W
48	Mihardjo, L. W. W., Sasmoko, Alamsyah, F., & Elidjen, E. (2019b). Digital leadership role in developing business model innovation and customer experience orientation in industry 4.0. *Management Science Letters*, *9*, 1749–1762	S
49	Mihardjo, L. W. W., Sasmoko, Alamsyah, F., & Elidjen, E. (2019c). The influence of digital leadership on innovation management based on dynamic capability: Market orientation as a moderator. *Management Science Letters*, *9*, 1059–1070	S
50	Mitchell, A. (2012). Interventions for effectively leading in a virtual setting. *Business Horizons*, *55*(5), 431–439	S/W
51	Narbona, J. (2016). Digital leadership, Twitter and Pope Francis. *Church, Communication and Culture*, *1*(1), 90–109	S
52	Nasution, R. A., Arnita, D., Rusnandi, L. S. L., Qodariah, E., Rudito, P., & Sinaga, M. F. N. (2020). Digital mastery in Indonesia: The organization and individual contrast. *Journal of Management Development*	S/W
53	Perizade, B., Eka, D., Widiyanti, M., Adam, M., & Muhtia, F. (2017). Virtual leadership: Concept, expectation and future. *International Journal of Applied Business and Economic Research*, *15*(10), 227–239	S
54	Peter, M. K., Kraft, C., & Lindeque, J. (2020). Strategic action fields of digital transformation: an exploration of the strategic action fields of Swiss SMEs and large enterprises. *Journal of Strategy and Management*, *13*(1), 160–180	S/W
55	Pomaza-ponomarenko, A. L., Hren, L. M., Durman, O. L., Bondarchuk, N. V., & Vorobets, V. (2020). Management mechanisms in the context of digitization of all spheres of society. *Revista San Gregorio*, *1*(42)	W

Table 5 (continued)

ID	Article	Dataset
56	Pradhan, B. B. (2019). Review paper on virtual leadership. *International Journal of Psychosocial Rehabilitation*, *23*(6), 633–638	S
57	Pulley, M. L., & Sessa, V. I. (2001). E-leadership: Tackling complex challenges. *Industrial and Commercial Training*, *33*(6), 225–230	S
58	Pulley, M. L., Sessa, V., & Malloy, M. (2002). E-leadership: A two-pronged idea. *T+D*, *56*(3), 34–47	S
59	Purvanova, R. K., & Bono, J. E. (2009). Transformational leadership in context: face-to-face and virtual teams. *The Leadership Quarterly*, *20*(3), 343–357	S/W
60	Purvanova, R. K., & Kenda, R. (2018). Paradoxical virtual leadership: reconsidering virtuality through a paradox lens. *Group & Organization Management*, *43*(5), 752–786	S/W
61	Richardson, J. W., Clemons, J., & Sterrett, W. (2020). How superintendents use technology to engage stakeholders. *Research in Educational Administration & Leadership*, *5*(4), 954–988	S
62	Roman, A. V., Van Wart, M., Wang, X., Liu, C., Kim, S., & McCarthy, A. (2019). Defining e-leadership as competence in ICT-mediated communications: An exploratory assessment. *Public Administration Review*, *79*(6), 853–866	S/W
63	Rubino-Hallman, S., & Hanna, N. K. (2007). New technologies for public sector transformation: A critical analysis of e-government initiatives in Latin America and the Caribbean. *Journal of E-Government*, *3*(3), 3–39	S
64	Saputra, N., & Hutajulu, G. E. (2020). Engaging the millennials at office: Tracking the antecedents of holistic work engagement. *Polish Journal of Management Studies*, *21*(1), 342–354	S/W
65	Sasmoko, S., Mihardjo, L. W. W., Alamsjah, F., & Elidjen, E. (2019). Dynamic capability: The effect of digital leadership on fostering innovation capability based on market orientation. *Management Science Letters*, *9*, 1633–1644	S
66	Schmidt, G. B. (2014). Virtual leadership: An important leadership context. *Industrial and Organizational Psychology*, *7*(2), 182–187	S
67	Sherk, K. E., Nauseda, F., Johnson, S., & Liston, D. (2009). An experience of virtual leadership development for human resource managers. *Human Resources for Health*, *7*(1), 1–3	S
68	Ticlau, T., Hintea, C., & Andrianu, B. (2020). Whether and how does the crisis-induced situation change e-leadership in the public sector? Evidence from Lithuanian public administration. *Transylvanian Review of Administrative Sciences*, *16*(SI), 149–166	S/W
69	Torre, T., & Sarti, D. (2020). The "way" toward e-leadership: Some evidence from the field. *Frontiers in Psychology*, *11*(2753)	S/W
70	Turesky, E. F., Smith, C. D., & Turesky, T. K. (2020). A call to action for virtual team leaders: Practitioner perspectives on trust, conflict and the need for organizational support. *Organization Management Journal*, *17*(4), 185–206	S
71	Van Wart, M., Roman, A., & Pierce, S. (2016). The rise and effect of virtual modalities and functions on organizational leadership: Tracing conceptual boundaries along the e-management and e-leadership continuum. *Transylvanian Review of Administrative Sciences*, *12*(SI), 102–122	S/W
72	Van Wart, M., Roman, A., Wang, X., & Liu, C. (2019). Operationalizing the definition of e-leadership: Identifying the elements of e-leadership. *International Review of Administrative Sciences*, *85*(1), 80–97	S/W
73	Wakefield, R. L., Leidner, D. E., & Garrison, G. (2008). A Model of conflict, leadership, and performance in virtual teams. *Information Systems Research*, *19*(4), 434–455	S

Table 5 (continued)

ID	Article	Dataset
74	Walvoord, A. A. G., Redden, E. R., Elliott, L. R., & Coovert, M. D. (2008). Empowering followers in virtual teams: Guiding principles from theory and practice. *Computers in Human Behavior*, *24*(5), 1884–1906	S/W
75	Wolor, C. W., Solikhah, S., Fidhyallah, N. F., & Lestari, D. P. (2020). Effectiveness of e-training, e-leadership, and work life balance on employee performance during COVID-19. *Journal of Asian Finance, Economics and Business*, *7*(10), 443–450	S/W
76	Yilmaz, R., Yilmaz, F. G. K., & Keser, H. (2020). Vertical versus shared e-leadership approach in online project-based learning: A comparison of self-regulated learning skills, motivation and group collaboration processes. *Journal of Computing in Higher Education*, *32*(3), 628–654	S
77	Zaccaro, S. J., & Bader, P. (2003). E-leadership and the challenges of leading e-teams: Minimizing the bad and maximizing the good. Organizational Dynamics, 31(4), 377–387	S/W
78	Ziek, P., & Smulowitz, S. (2014). The impact of emergent virtual leadership competencies on team effectiveness. *Leadership & Organization Development Journal*, *35*(2), 106–120	S/W
79	Zimmermann, P., Wit, A., & Gill, R. (2008). The relative importance of leadership behaviours in virtual and face-to-face communication settings. *Leadership*, *4*(3), 321–337	S/W

S, Scopus; W, Web of Science; S/W, Scopus and Web of Science

Appendix B

See Table 6 .

Table 6 Number of constructs identified in the study

Literature review + Round-01		Round-02 items (qty.)		Round-03 items (qty.)	Round-04 items (qty.)*	Final items (qty.)
Construct ID		Initial	Consensus achieved	Consensus achieved	Consensus achieved	Consensus achieved
Strategic focus dimension (all four rounds)						
S1	L/I	7	3	3	0	3
S2	L/I	8	6	6	0	6
S3	L/I	8	4	3	0	3
S4	L/I	9	6	5	1	6
S5	L/I	7	6	5	0	5
S6	L/I	7	5	4	1	5
S7	L/I	8	7	7	0	7
S8	L	5	0	0	0	0
S9	L/I	9	3	3	0	3
	Total	68	40	36	2	38
Delivery related dimension (all four rounds)						
D1	L/I	7	4	4	0	4
D2	L/I	8	0	0	0	0
D3	L/I	9	8	7	1	8
D4	L/I	6	5	5	0	5
D5	L/I	7	5	4	0	4
D6	L/I	8	0	0	0	0
D7	L/I	7	6	6	0	6
D8	L/I	6	3	2	1	3
D9	I	5	3	3	0	3
D10	L/I	5	0	0	0	0
	Total	68	34	31	2	33

Table 6 (continued)

Literature review + Round-01		Round-02 items (qty.)		Round-03 items (qty.)	Round-04 items (qty.)*	Final items (qty.)
Construct ID		Initial	Consensus achieved	Consensus achieved	Consensus achieved	Consensus achieved
Personal attribute dimension (all four rounds)						
P1	L/I	5	3	1	0	1
P2	L/I	7	3	2	0	2
P3	L/I	8	8	7	1	8
P4	L/I	8	7	7	0	7
P5	L/I	8	7	6	0	6
P6	L/I	9	6	6	0	6
P7	L	5	5	5	0	5
P8	L/I	5	4	2	1	3
P9	I	5	0	0	0	0
P10	L/I	5	0	0	0	0
P11	I	5	0	0	0	0
P12	I	5	5	3	0	3
P13	I	5	4	2	0	2
	Total	80	52	41	2	38
Interpersonal oriented dimension (all four rounds)						
I1	L/I	7	3	3	0	3
I2	L/I	8	4	4	0	4
I3	L/I	8	3	3	0	3
I4	L/I	8	0	0	0	0
I5	L/I	8	5	3	1	4
I6	L/I	8	7	7	0	7

Table 6 (continued)

Literature review + Round-01		Round-02 items (qty.)		Round-03 items (qty.)	Round-04 items (qty.)*	Final items (qty.)
Construct ID		Initial	Consensus achieved	Consensus achieved	Consensus achieved	Consensus achieved
I7	L/I	10	3	0	1	1
I8	L/I	9	4	4	0	4
I9	I	5	3	3	0	3
I10	I	5	0	0	0	0
	Total	76	32	27	2	28

L, derived from the literature; I, derived from the interviews; L/I, derived from the literature and the interviews. *Only the items that had not achieved consensus in Round-03 were considered for this round

Appendix C

See Table 7.

Table 7 Articles years 2021 and 2022

ID	Article	Dataset
1	Abbu, H., Mugge, P., & Gudergan, G. (2022). Successful digital leadership requires building trust: For companies to excel in the new, rapidly changing innovation environment, their leaders must focus on trust. Research Technology Management, 65(5), 29–33	S
2	Abbu, H., Mugge, P., Gudergan, G., Hoeborn, G., & Kwiatkowski, A. (2022). Measuring the human dimensions of digital leadership for successful digital transformation: Digital leaders can use the authors' digital leadership scale to assess their own readiness and ability to accelerate digital transformation. Research Technology Management, 65(3), 39–49	S/W
3	Aggarwal, S., & Kumar, A. (2022). Dealing with a new normal 'E-leadership': A study using bibliometric analysis and content analysis. Vision, 0, 1–17	S
4	Ahmad Tajuddin, S. N. A., Bahari, K. A., Al Majdhoub, F. M., Balraj Baboo, S., & Samson, H. (2022). The expectations of employability skills in the fourth industrial revolution of the communication and media industry in malaysia. Education and Training, 64(5), 662–680	S
5	Aktaş, E., Kurgun, A., Ozeren, E., & Kucukaltan, B. (2022). Real-Time Data Analysis (RTDA) and Proposed Innovative Business Models: A Conceptual Study of the Tourism Industry. International Journal of Organizational Leadership, 11, 4–20	W
6	Appelgren, E. (2022). Media management during COVID-19: Behavior of swedish media leaders in times of crisis. Journalism Studies, 23(5–6), 722–739	S
7	Askim, K., Czajkowski, N. O., & Knardahl, S. (2022). Exploring dynamic relationships between employees' personalities and psychosocial work factors. European Journal of Work and Organizational Psychology, 31(1), 1–21	S/W
8	Asraar Ahmed, K. A., Damodharan, V. S., Subha, K., Prasanna, S., & Rajesh, M. (2022). Impact of e-leadership competencies on employee behaviour. International Journal of Work Organisation and Emotion, 13(3), 187–211	S
9	Audretsch, D. B., & Belitski, M. (2021). Knowledge complexity and firm performance: evidence from the European SMEs. Journal of Knowledge Management, 25(4), 693–713	W
10	Ayalew, M., & Ayenew, Z. (2022). Do Paradoxical Virtual Leadership and Emotional Intelligence have Relationships? In Particular from Technology Dependence, Geographical Dispersion, and Human Capital Tensions. International Journal of Organizational Leadership, 11(1), 1–25	W
11	Balci, E. V., Tiryaki, S., Demir, Y., & Baloğlu, E. (2022). Digital leadership on Twitter: The digital leadership roles of sports journalists on Twitter. International Journal of Organizational Leadership, 11, 21–35	W
12	Baloch, Q. B., Maher, S., Iqbal, N., Shah, S. N., Sheeraz, M., Raheem, F., & Khan, K. I. (2022). Role of organizational environment in sustained organizational economic performance. Business Process Management Journal, 28(1), 131–149	S/W
13	Bellis, P., Trabucchi, D., Buganza, T., & Verganti, R. (2022). How do human relationships change in the digital environment after COVID-19 pandemic? The road towards agility. European Journal of Innovation Management, 25(6), 821–849	W
14	Ben Sedrine Doghri, S., Horchani, S. C., & Mouelhi, M. (2021). The E-leadership linking inter-organisational collaboration and ambidextrous innovation. International Journal of Innovation Management, 25(4), 2,150,043	S/W

Table 7 (continued)

ID	Article	Dataset
15	Benitez, J., Arenas, A., Castillo, A., & Esteves, J. (2022). Impact of digital leadership capability on innovation performance: The role of platform digitization capability. Information and Management, 59(2), 103,590	S/W
16	Bizilj, S., Boštjančič, E., & Sočan, G. (2021). Perceived efficacy of virtual leadership in the crisis of the covid-19 pandemic. Changing Societies and Personalities, 5(3), 389–404	S
17	Borah, P. S., Iqbal, S., & Akhtar, S. (2022). Linking social media usage and SME's sustainable performance: The role of digital leadership and innovation capabilities. Technology in Society, 68, 101,900	S/W
18	Brown, N. D., & Jacoby-Senghor, D. S. (2022). Majority members misperceive even "Win–win" diversity policies as unbeneficial to them. Journal of Personality and Social Psychology, 122(6), 1075–1097	S/W
19	Buluş, Ü. K., Işık, M., Yılmaz, M. M., & Buluş, B. (2022). The Importance of Leadership in the Time of Covid-19: The Example of Turkish Health Minister Fahrettin Koca's Youtube Shares. International Journal of Organizational Leadership, 11, 51–63	W
20	Busulwa, R., Pickering, M., & Mao, I. (2022). Digital transformation and hospitality management competencies: Toward an integrative framework. International Journal of Hospitality Management, 102, 103,102	S
21	Cahyadi, A., & Magda, R. (2021). Digital leadership in the economies of the G20 countries: A secondary research. Economies, 9(1), 32	S
22	Carranza, C. C. J., Bustamante, M. C. A., & Peiró, J. M. (2022). Sistematic review of empirical studies in E-leadership. Universitas Psychologica, 20	S
23	Chaudhary, P., Rohtagi, M., Singh, R. K., & Arora, S. (2022). Impact of leader's e-competencies on employees' wellbeing in global virtual teams during COVID-19: The moderating role of emotional intelligence. Employee Relations, 44(5), 1042–1057	S/W
24	Church, A. H., & Seaton, G. A. (2022). Learning agility as a key driver of leadership potential for talent identification, pipeline development, and succession planning in organizations. Consulting Psychology Journal, 74(3), 237–252	S/W
25	Cordova-Buiza, F., Aguirre-Parra, P., Garcia-Jimenez, M. G., & Martinez-Torres, D. C. (2022). Virtual leadership as a development opportunity in business context. Problems and Perspectives in Management, 20(2), 248–259	S
26	Desmaryani, S., Kusrini, N., Lestari, W., Septiyarini, D., Harkeni, A., Burhansyah, R.,... An-Driany, E. (2022). The role of digital leadership, system of information, and service quality on e-learning satisfaction. International Journal of Data and Network Science, 6(4), 1215–1222	S
27	Dewi, R. K., & Sjabadhymi, B. (2021). Digital Leadership as a Resource to Enhance Managers' Psychological Well-Being in COVID-19 Pandemic Situation in Indonesia. The South East Asian Journal of Management, 15(2), 2	W
28	Dörr, S. L., Schmidt-Huber, M., & Maier, G. W. (2021). The LEaD competence model: Leading effectively in the context of digital transformation. Gruppe Interact. Organ. Z. Angew. Organ, 52, 325–339	W
29	Elyousfi, F., Anand, A., & Dalmasso, A. (2021). Impact of e-leadership and team dynamics on virtual team performance in a public organization. International Journal of Public Sector Management, 34(5), 508–528	S/W
30	Erhan, T., Uzunbacak, H. H., & Aydin, E. (2022). From conventional to digital leadership: Exploring digitalization of leadership and innovative work behavior. Management Research Review, 45(11), 1524–1543	S/W
31	Fasbender, U., Gerpott, F. H., & Rinker, L. (2022). Getting Ready for the Future, Is It Worth It? A Dual Pathway Model of Age and Technology Acceptance at Work. Work, Aging and Retirement, ahead-of-print (ahead-of-print)	W

Table 7 (continued)

ID	Article	Dataset
32	Fischer, I., Beswick, C., & Newell, S. (2021). Rho AI – leveraging artificial intelligence to address climate change: Financing, implementation and ethics. Journal of Information Technology Teaching Cases, 11(2), 110–116	S
33	Gentilin, M., & Madrigal, M. A. G. (2021). Virtual leadership: Key factors for its analysis and management. Management Revue, 32(4), 343–365	S/W
34	Gouda, G. K., & Tiwari, B. (2022). Talent agility, innovation adoption and sustainable business performance: Empirical evidences from indian automobile industry. International Journal of Productivity and Performance Management, 71(6), 2582–2604	S/W
35	Guo, Y., Zou, T., & Shan, Z. (2022). Taxation strategies for the governance of digital business model—An example of china. Frontiers in Psychology, 13, 5842	S/W
36	Harbani, Muna, N., & Judiarni, J. A. (2021). Digital leadership in facing challenges in the era industrial revolution 4.0. Webology, 18(Special Issue), 975–990	S
37	Hutajulu, R. S., Susita, D., & Eliyana, A. (2021). The effect of digitalization and virtual leadership on organizational innovation during the COVID-19 pandemic crisis: A case study in Indonesia. The Journal of Asian Finance, Economics and Business, 8(10), 57–64	W
38	Jackson, N. C., & Dunn-Jensen, L. M. (2021). Leadership succession planning for today's digital transformation economy: Key factors to build for competency and innovation. Business Horizons, 64(2), 273–284	S/W
39	Karakose, T., Kocabas, I., Yirci, R., Papadakis, S., Ozdemir, T. Y., & Demirkol, M. (2022). The development and evolution of digital leadership: A bibliometric mapping approach-based study. Sustainability (Switzerland), 14(23), 16,171	S
40	Karippur, N. K., & Balaramachandran, P. R. (2022). Antecedents of effective digital leadership of enterprises in asia pacific. Australasian Journal of Information Systems, 26	S
41	Kashive, N., Khanna, V. T., & Powale, L. (2022). Virtual team performance: E-leadership roles in the era of COVID-19. Journal of Management Development, 41(5), 277–300	S/W
42	Komp, R., Kauffeld, S., & Ianiro-Dahm, P. (2022). The concept of health-promoting Collaboration—A starting point to reduce presenteeism? Frontiers in Psychology, 12, 782,597	S/W
43	Krehl, E. -., & Büttgen, M. (2022). Uncovering the complexities of remote leadership and the usage of digital tools during the COVID-19 pandemic: A qualitative diary study. German Journal of Human Resource Management, 36(3), 325–352	S/W
44	Kulshreshtha, K., & Sharma, G. (2021). Understanding e-leadership: Please mind the gap. Technological Forecasting and Social Change, 168, 120,750	S/W
45	Leung, Y. K., Franken, I., Thurik, R., Driessen, M., Kamei, K., Torrès, O., & Verheul, I. (2021). Narcissism and entrepreneurship: Evidence from six datasets. Journal of Business Venturing Insights, 15, e00216	S
46	Li, W. -., Li, S., Feng, J. J., Wang, M., Zhang, H., Frese, M., & Wu, C. -. (2021). Can becoming a leader change your personality? an investigation with two longitudinal studies from a role-based perspective. Journal of Applied Psychology, 106(6), 882–901	S/W
47	Liebermann, S. C., Blenckner, K., Diehl, J. -., Feilke, J., Frei, C., Grikscheit, S.,... Reinhardt, J. (2021). Abrupt implementation of telework in the public sector during the COVID-19 crisis: Challenges to transformational leadership. Zeitschrift Fur Arbeits-Und Organisationspsychologie, 65(4), 258–266	S/W
48	Liu, C., Li, J., Tao, Z., Wang, Z., Chen, C., & Dong, Y. (2021). Prestige and dominance as assessed by friends, strangers, and the self. Personality and Individual Differences, 179, 110,965	S/W
49	Løkke, A. -. (2022). Leadership and its influence on employee absenteeism: A qualitative review. Management Decision, 60(11), 2990–3018	S

Table 7 (continued)

ID	Article	Dataset
50	Madsen, H., & Matusitz, J. (2022). Benefits of google technologies for organizations: Perspectives from adaptive structuration theory. International Journal of Technology Management and Sustainable Development, 21(1), 5–18	S
51	Magesa, M. M., & Jonathan, J. (2022). Conceptualizing digital leadership characteristics for successful digital transformation: The case of tanzania. Information Technology for Development, 28(4), 777–796	S
52	Mander, R., Hellert, U., & Antoni, C. H. (2021). Self-leadership strategies for coping with flexibility requirements of digital work with a high degree of latitude for time, place and scope for action—a qualitative study. Gruppe. Interaktion. Organisation. Zeitschrift für Angewandte Organisationspsychologie (GIO), 52, 163–171	W
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54	Meadows, S., & De Braine, R. (2022). The work identity of leaders in the midst of the COVID-19 pandemic. Frontiers in Psychology, 13, 1–10	S/W
55	Miglioretti, M., Gragnano, A., Margheritti, S., & Picco, E. (2021). Not all telework is valuable. [No todo teletrabajo es valioso] Revista De Psicologia Del Trabajo y De Las Organizaciones, 37(1), 11–19	S/W
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57	Nieken, P. (2022). Charisma in the gig economy: The impact of digital leadership and communication channels on performance. The Leadership Quarterly, ahead-of-print(ahead-of-print)	S
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61	Peiró, J. M., & Martínez-Tur, V. (2022). 'Digitalized' competences. A crucial challenge beyond digital competences. Revista De Psicologia Del Trabajo y De Las Organizaciones, 38(3), 189–199	S/W
62	Pham, H. Q., & Vu, P. K. (2022). Unravelling the potential of digital servitization in sustainability-oriented organizational Performance—Does digital leadership make it different? Economies, 10(8), 185	S
63	Robertson, J., Botha, E., Walker, B., Wordsworth, R., & Balzarova, M. (2022). Fortune favours the digitally mature: The impact of digital maturity on the organisational resilience of SME retailers during COVID-19. International Journal of Retail and Distribution Management, 50(8–9), 1182–1204	S/W
64	Ruiner, C. & Klumpp, M. (2022). Autonomy and new modes of control in digital work contexts – a mixed-methods study of driving professions in food logistics, Employee Relations, 44(4), 890–912	W
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Table 7 (continued)

ID	Article	Dataset
66	Rybnikova, I., Juknevičienė, V., Toleikienė, R., Leach, N., Āboliņa, I., Reinholde, I., & Sillamäe, J. (2022). Digitalisation and e-leadership in local government before COVID-19: Results of an exploratory study. Forum Scientiae Oeconomia, 10(2), 173–191	S
67	Sandberg, D. S., Pennington, C. M., & Lindquist, M. A. (2022). Virtual leadership: CEOs and C-level executives of healthcare organizations in the united states reimagined new roles as virtual leaders. Journal of Leadership Studies, 16(3), 61–69	S/W
68	Sarfraz, M., Ivascu, L., Abdullah, M. I., Ozturk, I., & Tariq, J. (2022). Exploring a pathway to sustainable performance in manufacturing firms: The interplay between innovation capabilities, green process and product innovations and digital leadership. Sustainability (Switzerland), 14(10), 5945	S
69	Schiuma, G., Schettini, E., & Santarsiero, F. (2021). How wise companies drive digital transformation. Journal of Open Innovation: Technology, Market, and Complexity, 7(2), 122	S
70	Schiuma, G., Schettini, E., Santarsiero, F., & Carlucci, D. (2022). The transformative leadership compass: Six competencies for digital transformation entrepreneurship. International Journal of Entrepreneurial Behaviour and Research, 28(5), 1273–1291	S/W
71	Schmidt, G. B., & Van Dellen, S. A. (2022). Leadership of place in virtual environments. Leadership, 18(1), 186–202	S/W
72	Sotoudehnia, M. (2021). Making blockchain real': Regulatory discourses of blockchains as a smart, civic service. Regional Studies, 55(12), 1857–1867	S
73	Stremersch, S., Camacho, N., Keko, E., & Wuyts, S. (2022). Grassroots innovation success: The role of self-determination and leadership style. International Journal of Research in Marketing, 39(2), 396–414	S/W
74	Suci, R. P. (2021). SMEs performance optimization malang raya based leadership. Review of International Geographical Education Online, 11(4), 1398–1405	S
75	Susilawati, D. M., Suryanto, & Windijarto. (2021). Transforming the digital leadership to improve public service performance in the COVID-19 outbreak. Economic Annals-XXI, 188(3–4), 31–38	S
76	Tan, R., & Antonio, F. (2022). New insights on employee adaptive performance during the COVID-19 pandemic: Empirical evidence from indonesia. Journal of Entrepreneurship, Management and Innovation, 18(2), 175–206	S/W
77	Tautz, D. C., Schübbe, K., & Felfe, J. (2022). Working from home and its challenges for transformational and health-oriented leadership. Frontiers in Psychology, 13, 1–17	S/W
78	Thapa, S., Voola, A., & Yesseleva-Pionka, M. (2022). Leadership and digital communication in australian SMEs amid COVID-19. Journal of the International Council for Small Business, 3(1), 50–55	S
79	van Gelder, M., van Veldhoven, M., & van de Voorde, K. (2022). Wellbeing in line managers during mandatory working from home: How work and personal factors combine. Frontiers in Psychology, 13, 1–18	S/W
80	Vanichchinchai, A. (2021). Assessing lean satisfaction and its enablers: A care provider perspective. Operations Management Research, 14(1–2), 95–106	S/W
81	Wallace, D. M., Torres, E. M., & Zaccaro, S. J. (2021). Just what do we think we are doing? Learning outcomes of leader and leadership development. The Leadership Quarterly, 32(5), 101,494	S/W
82	Wang, L., Chen, X. P., & Yin, J. (2022). Leading via virtual communication: A longitudinal field experiment on work team creativity in an extreme context. Asia Pacific Journal of Management, 1–37	W
83	Wang, M., & Yang, Y. (2022). An empirical analysis of the supply chain flexibility using blockchain technology. Frontiers in Psychology, 13, 1–17	S/W

Table 7 (continued)

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84	Wang, T., Lin, X., & Sheng, F. (2022). Digital leadership and exploratory innovation: From the dual perspectives of strategic orientation and organizational culture. Frontiers in Psychology, 13, 1–19	S/W
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86	Weber, E., Büttgen, M., & Bartsch, S. (2022). How to take employees on the digital transformation journey: An experimental study on complementary leadership behaviors in managing organizational change. Journal of Business Research, 143, 225–238	S/W
87	Widyaputri, P., & Sary, F. P. (2022). Digital leadership and organizational communication toward millennial employees in a telecommunication company. Corporate Governance and Organizational Behavior Review, 6(4), 157–167	S
88	Wittmer, J. L. S., & Hopkins, M. M. (2022). Leading remotely in a time of crisis: Relationships with emotional intelligence. Journal of Leadership and Organizational Studies, 29(2), 176–189	S/W
89	Yacob, P., & Peter, D. (2022). Perceived benefits of sustainable digital technologies Adoption in manufacturing SMEs. International Journal of Innovation and Technology Management, 19(04), 2,250,012	W
90	Yang, H., Lin, Z., Chen, X., & Peng, J. (2022). Workplace loneliness, ego depletion and cyberloafing: Can leader problem-focused interpersonal emotion management help? Internet Research, ahead-of-print (ahead-of-print)	S/W
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92	Zaytsev, A. A., Blizkyi, R. S., Rakhmeeva, I. I., & Dmitriev, N. D. (2021). Building a model for financial management of digital technologies in the areas of combinatorial effects. Economies, 9(2), 52	S
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94	Zhang, Y., Zhao, R., & Yu, X. (2022). Enhancing virtual team performance via high-quality interpersonal relationships: Effects of authentic leadership. International Journal of Manpower, 43(4), 982–1000	S/W
95	Zhu, J., Zhang, B., Xie, M., & Cao, Q. (2022). Digital leadership and employee creativity: The role of employee job crafting and person-organization fit. Frontiers in Psychology, 13, 1–16	S/W
96	Zulu, S. L., & Khosrowshahi, F. (2021). A taxonomy of digital leadership in the construction industry. Construction Management and Economics, 39(7), 565–578	S/W

S-Scopus; W – Web of Science; S/W – Scopus and Web of Science

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Declarations

Conflict of interest The authors have no conflict of interest to disclose.

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