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Causal effect between digitalisation and agility: the leadership mediating role

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Abstract: Digitisation is an essential aspect concerning various academic fields and affecting practice. Digital contribution was the subject of multiple research streams. The present study seeks to examine relationships among digitalisation towards organisational agility through the mediating effect of leadership. To achieve the purpose, we conducted a quantitative study on 347 companies from the industrial sector. Data was gathered using a questionnaire survey. Based on structural equation modelling, the findings demonstrate that digitalisation is an important driver of organisational agility. The results confirm a positive mediating role of leadership on the verified link. The study highlighted that leadership is more than an individual behaviour. Leadership depends on the collective and it is dispensed across the entire organisation during the digital change management. The findings give original support for practitioners and academics. The study contributed to the knowledge field by providing empirical evidence and therefore a valuable knowledge repository about the leadership and its effect on agility in a digital world.

Keywords: digital; organisational agility; leading; mediated model.

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1 Introduction

Firms are faced with challenges concerning their survival. Crises and pandemics have constrained organisations to follow new strategies and procedures to stay afloat (Kinnunen and Georgescu, 2020; Klein and Todesco, 2021). Managing changes has conducted to the acquisition of new management abilities, tools, practices and strategies.

The use of technologies has considerably changed the way people work and live. The digital revolution has been compared to an industrial revolution (Gous, 2021). Organisations have adopted agility to create and respond to change (Stettina and Hörz, 2015).

Digitally mature organisations impact and react more efficaciously to change. They are more likely to be agile, collaborative, experimental and risk-tolerant (Rader, 2019). The literature review shows that the link between digitalisation and agility was of interest to researchers and practitioners for a long time (Cornish, 1982; Wördenweber and Weissflog, 2006). Thus, Kenny (1983) tells his story of using digital technology to foster customer agility.

In the information systems literature, various studies have shown that information and communication technologies (ICT) support organisational agility (Roberts and Grover, 2012; Chen et al., 2014; Park et al., 2017). In particular, these studies spotlight the functionalities that business intelligence technologies and communication technologies offer to meet the information processing challenges in the era of Big data. These technologies help organisations in quickly finding and reacting to market opportunities and menaces. Although these studies present ICT as a technological antecedent to support organisational agility, opposite studies find that ICT is an inhibiting factor of agility (Galliers, 2006; Leonardi and Barley, 2008; Liang et al., 2017). Therefore, this contradiction implies the need to understand precisely the value of digitalisation in organisational agility.

Moreover, despite the practitioner involvement to show the value of technological factors, few academic studies explored the other organisational capabilities allowing the effective exploitation of technological resources in companies (Sambamurthy et al., 2003; Trinh-Phuong et al., 2012). Researchers confirm that technologies bring functionalities influencing identification and response agility, but leaders have to be vigilant and attentive in order to make sense of ICTs report (Thatcher et al., 2018). In this sense, Lewis et al. (2014) see a need for leadership so that companies can make quick decisions in changing environments. Additionally, the need for leaders is perceived to be an integral component of thriving organisational change (Fourné et al., 2014; Mansaray, 2019). However, although the literature demonstrated that leadership can influence the change implementation, it has been difficult to analyse the results in a way that can provide accurate conclusions (Oreg and Berson, 2019).

To fill this gap, the present research expands the theoretical understanding of how digitalisation promotes agility in enterprises without omitting the leader's role. Leaders are seen as influencing the implementation of digital technologies and projects, while setting standards and an appropriate culture within the organisation. However, leadership is shaped by the introduction of digitalisation. Leadership tasks become conducted through electronic communication channels and information technologies (Avolio et al., 2014). It turns out that research on agility is at an embryonic stage. Its conceptualisation is not yet complete and therefore remains open to all research. In this context, the present study focuses on the digitalisation effect on the organisational agility detecting the moderating effect of leadership. The work aims to highlight the role of leadership in the interference of the digitalisation-organisational agility dual. The paper tents to overcome the literature shortcomings and to contribute to research in this field.

This article is structured as following. Firstly, an exhaustive literature review helps to explain the link between research variables. Subsequently, a conceptual model and

research hypotheses are propounded. Then, we describe the adopted methodology. Finally, we discuss the results and conclude.

2 Theoretical background

2.1 Digitalisation

The interest in digitalisation was combined with the use of ICT. Thus, the seminal works speak of the data transfer from tangible media to digital media (Rattan, 1984). Other studies emphasise the digitalisation use to improve the work quality (Rintala and Suolanen, 2005). In addition, the digitalisation subject was treated in direct connection with the exercise of influence on the consumer by the mass media (Isotalus et al., 2003).

The literature review on digitalisation is distinguished by the planetary enthusiasm of researchers trying to give a universal definition to a new reality involving major changes in different spheres of human activities (Tchameni Ngamo, 2007). When raising the concept of digitalisation, several terminologies are used. Thus, digitisation refers to the conversion of analogue data into digital form (Parviainen et al., 2017). Digital transformation is defined as changes in ways of working, roles, and business output caused by adoption of digital technologies (Al Mashalah et al., 2022). Digital maturity is a measure of both digital capabilities and digital leadership for encouraging and initiating digital transformation (Robertson et al., 2022). In the present work, digitalisation refers to the adoption and rise in usage of digital or computer technology (Brennen and Kreiss, 2014). Digitalisation is considered as a strategic factor favouring planning and improving financial performance (Ojha et al., 2023).

Digitalisation is linked to ICT encompassing several innovative techniques in different fields such as audiovisual, information technology (IT) and telecommunications facilitating storage operations and the process to obtain information in organisations. The combination between these different elements provides not only the information processing but also its transmission (Tchameni Ngamo, 2007). Roberts and Grover (2012) focus on IT infrastructure to show that analytical tools and web-based technologies are key enablers for organisations to develop their identification and response capabilities. Thus, a variety of digital collaboration tools serves as basic enablers for the daily business execution across the globe, independent of physical locations and time zones (Busse and Weidner, 2020).

2.2 Organisational agility

Studies on agility began in the USA in 1992 coinciding with the birth of a company's evolving global vision (Gould, 1997). At the end of the 1990s, researchers began to talk about agility as a dimension of the firm's competitiveness (Vokurka and Fliedner, 1998). In recent research, agility becomes a strategic capability affecting organisational competitiveness through human resources, supply chains and decisions (Amini and Rahmani, 2023; Athamneh and Jais, 2023; Aldhaheeri and Ahmad, 2023).

Over the years, scholars have defined this notion from different perspectives. First, theorists are interested in the agility levels. At the individual level, being agile means being able to contribute to the company's bottom line through its technology and human resources (Dove, 1994; Cao and Dowlatshahi, 2005) which presuppose the empowerment

of individuals (Shafiabady et al., 2023). Individual agility contributes to the bottom line of the company which is constantly reorganising its technological and human resources in order to be able to respond to opportunities (Dashtpeyma and Ghodsi, 2022). At the organisational level, agility is the ability to respond to short-term changes in demand or supply quickly and handle external disruptions smoothly (Lee, 2004). The organisation responds to environmental changes in order to quickly seize market opportunities (Park et al., 2017).

Other research focuses on agility at the business partners' level. This agility incorporates the rapid reaction to changes in customer demand (Baker, 2008). In this case, the integration degree and the information system coordination state play a key role in the agility degree (Swafford et al., 2008). In order to be agile, the company must be able to act profitably. The authors add that being agile requires effective knowledge management and application (Dove, 2002). Sambamurthy et al. (2003) consider agility as the ability to detect innovation opportunities and seize competitive market opportunities to gather the necessary assets, knowledge and relationships quickly. Besides the agility levels, theorists mention its dimensions. Lu and Ramamurthy (2011) distinguish two agility dimensions: the market capitalisation agility and the operational adjustment agility. The first refers to an organisation's ability to respond quickly to change in order to profit through continuous product/service improvement to reflect customer needs. The second is the ability of the company's internal operational process to respond quickly to changes in demand.

Several studies consider that identification, decision-making and response capacities are the three main components of agility (Nazir and Pinsonneault, 2012; Overby et al., 2006). The identification task consists, first, in the collection of information relating to changes in customer preferences, the competitors strategic movements and the emergence of new technologies and new regulations. Second, this task includes the activity of filtering unimportant information (El Sawy, 1985). This is followed by a decision-making task (Daft and Weick, 1984; Dutton and Duncan, 1987) which ultimately leads to responding in a reactive and/or proactive manner to environmental changes (Smircich and Stubbart, 1985; Weick et al., 2005). Firms will reconfigure resources in order to respond with new competitive actions (Daft and Weick, 1984; Teece et al., 1997) such as launching new products/services or changing policies with strategic partners and key customers (D'Aveni, 1994; Ferrier et al., 1999; Thomas et al., 1993).

2.3 Leadership

The concept of organisational agility has been increasingly decisive since the pandemic in facing the challenges encountered by companies in recovering employee commitment, readjusting their strategies and regaining their competitiveness. Authors point out that leadership represents an organisational antecedent allowing companies to develop their identification and response capacities in order to react (Prabhu and Srivastava, 2023). The leadership theme is of great scientific concern (Cogliser and Brigham, 2004; Horchani et al., 2022). According to Bass and Stogdill (1990) leadership is one of the oldest universal concepts in the world. Indeed, the success, development and failure of any society depend mainly on leaders (Pounder et al., 1995). Several other researchers believe that the leadership phenomenon exists in every community and plays a central role in the organisations' functioning (House and Aditya, 1997; Parry and Bryman, 2006). Despite the literature richness on leadership, authors deplore its lack of conceptualisation (Conger

and Kanungo, 1992). Indeed, each author defines leadership according to his convictions (Den Hartog et al., 1999).

Hence, Stogdill (1950) states that leadership is the process of influencing the group activities. Authors present leadership as an individual ability to influence, motivate and enable others in contributing to the organisation's effectiveness and success. It is an orientation and decisive process influence of a person on the human group action with a view to implementing a policy and achieving objectives (Hersey and Blanchard, 1982; Plane, 2015). Antonakis et al. (2004) assert that the leadership conceptualisation is strongly influenced by the individual experience. These leadership definitions are essentially due to richness in the researchers' visions.

3 The relationship among digitalisation, organisational agility and leadership

3.1 Digitalisation and organisational agility relation

Several studies shown that digitalisation play a perceptible role in achieving organisational agility. The first works carried out on the link between digitalisation and agility within the organisation focused on the facilitation of responsiveness of supply chains at the request of consumers in disturbance (Taylor et al., 1993). Many studies investigated the impact of ICT on agility using various models and approaches (Sambamurthy et al., 2003; Overby et al., 2006; Chakravarty et al., 2013; Lee et al., 2015). Researchers wonder how digitalisation can promote organisational agility. Indeed, Lu and Ramamurthy (2011) shown that the company's digitalisation capabilities lead to greater organisational agility. These capabilities are particularly linked to proactive orientation of ICT like the ability to explore and experiment with new technologies and to exploit them in creating new business opportunities. Accordingly, companies continually acquire digital capabilities in order to successfully manage and exploit their resources.

Later, Lee et al. (2015) introduced the concept of computational ambidexterity. It is defined by two components, exploration and exploitation (March, 1991; Nazir and Pinsonneault, 2012). Depending on the environment turbulence, companies use digitalisation to explore opportunities in new markets or exploit opportunities in their extant markets. These authors shown that in a less dynamic environment, an overdeveloped ICT ambidexterity have a direct negative effect on organisational agility. In addition, Park et al. (2017) conceptualise organisational agility as a form of dynamic capability that includes identification, decision-making and response agility. They find that in fast-paced and unpredictable environments, business intelligence and communication technologies are essential to be agile in the identification and response processes.

Indeed, these technologies provide organisations with functionalities allowing managers to identify and respond to changes in real time (Brynjolfsson and McAfee, 2012). Then, digitalisation in business leads to changes in the working way. The necessity for accelerated response to prevailing changes in the digital era, modify the old slow hierarchical models into flatter organisations in which employees are more empowered in terms of making decision (Jääskeläinen and Savolainen, 2003; Khan, 2016; Banks et al., 2022).

3.2 *Digitalisation and leadership relation*

The investigation shows that the digitalisation effect on leadership was felt, in the early days, through the pressure exerted by civilian leaders on military leaders through media coverage (Fox, 1995). In the business world, the transition from a traditional work environment to a virtual environment is caused essentially by the development of ICT. This environment, characterised by the complexity and rapidity of changing needs, has significantly changed organisational modes as well as the leadership characteristics (Hagel, 1999; Horchani and Zouaoui, 2021; Hussein, 2023). The difference between the traditional work environment and the e-environment is obvious. This necessarily involves leadership skills distinct from traditional skills. Indeed, several authors highlight the difficulties and changes faced by leaders in virtual environments. Thus, free access to information and the media increase the pressure on managers who have to justify their decisions, have easier access to the skills necessary for the company, might master the indelible communication nature and the professional isolation of workers (Avolio and Kahai, 2003).

Leaders provide remote follow-up and perception problems (Kurland and Egan, 1999). In this regard, several authors focused on identifying the leader divergence Kanter (1999) specifies that leader behaviour in the digital age focus on trust as a determining variable for cooperation strategies. Some authors advance the notion of e-leader defined as a social influence process using advanced information technologies to produce changes in thoughts, feelings, attitudes, behaviours or individuals' and teams' performance (Avolio et al., 2000).

The e-leadership literature deals with the leader's essential skills under the digitalisation influence. Thus, the e-leader know how to communicate effectively with his collaborators by mastering communication technologies (Annunzio, 2001). Khawaj (2009) emphasises his vigilance, his reactivity and his willingness to learn and relearn the adventure meaning. Van Wart et al. (2017) affirmed that the e-leader masters different technological tools. He has the ability to deal with different potential problems such as breakdowns and cybernate-crime. Other works advance the concept of technological leader which highlights the leader's function rather than his characteristics to develop in his collaborators the spirit of using technology within the organisation (Flanagan and Jacobsen, 2003; Srivastava and Joshi, 2018).

The technological leader develops, direct, manage and implement information technologies in organisations (Dexter, 2011). He has advanced skills in ICT (Wei et al., 2017), so that he can develop the ICT potential in organisations and stimulate the employees to use ICT in a more effective way (Ugur and Koç, 2019; Karaatmaca et al., 2020). Technological leaders respond to the dynamic challenges imposed by the digital revolution era to develop and make change in the organisational culture (Ertmer et al., 2002). This leadership style is characterised by a technological vision allowing better understand and evaluating the latest technological trends in order to make decisions that will technologically guide the organisation (Carleton, 2010; Weng and Tang, 2014). Thus, the technology leader reinvents himself compared to the traditional approach in order to improve the organisational performance and better change management. In addition, he help in increasing the employees' ability to use technological knowledge and encourage the knowledge sharing (Srivastava and Dhar, 2016).

Recent research mentions the digital leadership notion (Tigre et al., 2023). In effect, leadership in the digital context needs to be more decentralised. The digital leadership use

the collective competence and intelligence in the company. Leaders place particular value on social skills and personal skills, such as: empathy, conflict management, interdisciplinary, openness to innovation and change, resilience and communication (El Akid, 2023).

3.3 Leadership and agility relation

To highlight the link between leadership and agility, researchers coined the term agile leadership representing the ability to effectively lead employees in complex, fast-paced, and constantly changing conditions while taking wise and effective actions (Joiner and Josephs, 2007). They noted that agility stands out from related parameters such as flexibility and adaptability, because it requires proactive actions instead of a passive or reactive position (Busse and Weidner, 2020). Research emphasises that leaders can only be successful if they incessantly ameliorate their work environment in terms of people, processes, structures and technologies (Horney et al., 2010). Then, agile organisations necessitate vision-based leadership that intelligibly precise corporate goals and the ways for achieving them (Nagel and Bhargava, 1994).

Leadership offers dynamic flexibility in the development and management of exchange relationships with the company's various partners thanks to the diffusion of a high trust level (Shin and Park, 2021). These exchange relationships encourage or discourage compliance with the leader's requests (Grienberger et al., 1997). Likewise, advanced levels of exchange relationships lead to high-quality relationships, which are characterised by shared trust, loyalty, and relationship longevity (Chang et al., 2016). The built relationship may exhibit a stronger desire to aid and support a leader during disruptive events. The strength and quality of connectivity is directly related to the agility level through interconnected operations management between multiple tiers of suppliers and buyers (Carvalho et al., 2012).

3.4 The mediating role of leadership on the relationship between digitalisation and organisational agility

Several researchers find that leadership style has a positive influence on employees' self-efficacy in using ICT (Weng et al., 2014; Srivastava and Dhar, 2016). Authors indicate that when leaders provide an environment conducive to learning new technologies and give the necessary resources, employee confidence in learning new technologies and Internet-related skills increases. However, a low level of leadership oriented towards digitalisation lead to low employee efficiency in using technologies (Srivastava and Dhar, 2016). In this regard, Piper and Hardesty (2005) stated that investments in technology infrastructure alone are insufficient, as organisations need a leadership style to increase efficiency and employee engagement. Furthermore, authors use the management team theory 'top management team (TMT)' as an organisational factor supporting organisational agility (Hambrick et al., 1996; Eisenhardt and Martin, 2000; Kaplan, 2008; Park et al., 2017). This theory shows that senior managers are a critical success factor determining how organisations adopt and use ICT (Markus, 1983; Cooper et al., 2000; Wixom and Watson, 2001). It helps find how an organisation interprets business events in order to formulate organisational actions that respond to environmental changes (Eisenhardt and Martin, 2000; Hambrick et al., 1996; Kaplan, 2008). Additionally, Nijssen and Paauwe (2012) stated that several studies mention the

impact of the managers' attitude on the implementation and adoption of organisational practices adapted to the context.

Along the same lines, leadership encouraging the new technologies' use is seen as an organisational factor providing a technology-oriented work environment (Abhyankar and Dalvie, 2013). Indeed, to make strategic decisions in fast and unpredictable environments, leadership plays a central role in overcoming disagreements and aiding decision-making (Daft and Lengel, 1986). Leadership can amplify the relationship between IT and organisational agility because it helps determine how organisations adopt business intelligence and communication technologies (Cooper et al., 2000; Markus, 1983; Wixom and Watson, 2001; Park et al., 2017). These information technologies furnish functionalities to effectively support the leader's tasks in the organisational agility process like identifying and responding. They help foster innovation by encouraging experimentation, communication and collaboration (Davenport and Harris, 2007; Houghton et al., 2008).

Then, when senior executives influence organisations to adopt and use technologies, the organisation will develop their agility in identification, decision-making and response (Park et al., 2017). The leadership style plays an essential role in identifying and responding to environmental change (Eisenhardt, 1989; Hambrick et al., 1996; Houghton et al., 2008). This leadership develop the level of decision-making in crisis (Ochieng Walumbwa et al., 2004; Hur et al., 2011; Panagopoulos and Dimitriadis, 2009). Consequently, leadership enshrines all the necessary skills allowing organisations to become agile by encouraging the adoption and use of technologies with developing the organisational agility process of identifying, making decisions and responding.

The hypotheses based on the results of the research and theoretical backgrounds are presented below.

Hypothesis 1 Digitalisation is positively related to the organisational agility.

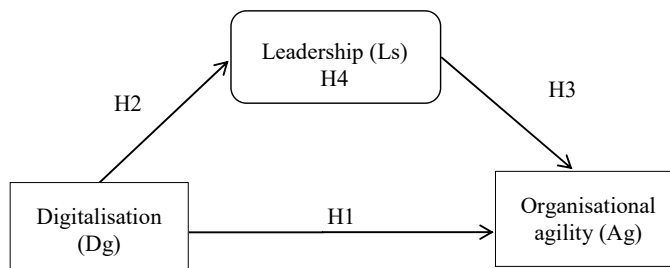
Hypothesis 2 Digitalisation is positively related to the leadership.

Hypothesis 3 Leadership is positively related to the organisational agility.

Hypothesis 4 Leadership mediates the relationship between digitalisation and organisational agility.

The hypothesised relationships are illustrated in Figure 1.

Figure 1 The research model of the study



4 Methodology

In this study which aims to determine the relations between digitalisation, organisational agility and leadership, primarily, information about samples and scales was delineate. Data was prepared in order to be appropriate for statistical analysis. Then, confirmatory factor analysis of each variable was performed by IBM SPSS statistics and then correlations between variables were determined. The partial least squares structural equation modelling PLS-SEM was used in analysis and result reporting. Findings were compared with the existing literature.

4.1 Samples

To test the research hypotheses, a quantitative study was performed with a reasoned sample of Tunisian managers working in the industrial sector. Hence, the sampling method is founded on a rational selection. This non-probabilistic sampling method enables determining exactly the sample composition respecting the criteria fixed by the researcher (Thietart, 2001). In our study, the data collection tool is the questionnaire. The language of the questionnaire elements (items) is English. The translation into French was done, first, by the author of this work. In addition, the English text was translated into French by a bilingual teacher (English-French). A preliminary version of the text in French was transmitted to another bilingual teacher for its translation into English. This English version has been compared to the original English version. The two versions are almost identical.

Of the 700 questionnaires online distributed only 347 questionnaires were found to be useful for further analysis, which indicates a response rate of 49.57%. Analysis of the survey data shows that among the responses received, no questionnaire with missing responses was found. However, 18 questionnaires were found completed without proper engagement. The same option was chosen throughout the questionnaire. These were removed from the dataset. To eliminate the possibility of non-response bias, we followed the instructions of Armstrong and Overton (1977) in comparing the characteristics of primal and tardy responders in the sample. No significant variation subsists based on size or type of business.

The respondents in this survey were in Tunisia. More than half of them are located in the central region (51.6%; $n = 179$). Nearly half of respondents are managing directors/founders (40.3%; $n = 140$). Majority of the enterprises' age (71.2%; $n = 247$) were above ten years. According to type of industry that 40.1% ($n = 139$) belong to the textile and clothing industry. In terms of the employee total number, the category of 1–250 (small and medium enterprises) was the largest group (83.3%; $n = 289$).

To fix the sample size, the requirement of 10 responses for each item used in the questionnaire was observed, which is considered large enough to represent a population (Krejcie and Morgan, 1970). The questionnaire contains 17 items. Thus, the study covers a fairly large sample of 347 respondents.

4.2 Measures

Five-point Likert scale was used in all measures, whereby 1 represents 'strongly disagree', 2 represents 'disagree', 3 represents 'neutral', 4 represents 'agree' and 5 represents 'strongly agree'.

4.2.1 Digitalisation scale

The digitalisation scale, which was adapted from Song et al. (2008), Yu et al. (2017), and validated by Garg and Kumar (2020, 2022) was adopted. The scale is one-dimensional and includes six items. The scale expressions are: ‘We use IT / digital technology for facilitating technical knowledge creation’; ‘We use IT/ digital technology for facilitating market knowledge creation’; ‘We use IT/ digital technology for communication (e.g., inter-departments, suppliers, customers, channel members, etc.)’ ; ‘We use IT/ digital technology for marketing and promotion purposes’ ; ‘We are moving towards automation or digitalisation of processes’; ‘We use IT / digital technology to develop new product or service’.

4.2.2 Organisational agility scale

To measure organisational agility, the scale developed and validated by McCann et al. (2009) was used. There are many reasons for choosing this scale. First, the study by McCann et al. (2009) is a basic reference in studies conducted on agility and resilience, even the most recent (Akkaya and Qaisar, 2021; Holbeche, 2023). Then, in this study, the respondents are senior executives, managers and high-level human resource professionals responsible or intimately involved with change management initiatives within their organisations. Similarly, the study was conducted in an environmental disruption context. Moreover, some items in the used scale were identified in the qualitative study conducted by Pinho (2023), which reflects the scale’s contextual compatibility in the digitalisation era .

The McCann et al. (2009) scale consists of one dimension with five items. Scale expressions are as following: ‘Our organisation is open to change’; ‘Our organisation actively and widely scans for new information about what is going on’; ‘Our organisation is good at giving meaning to ambiguous and uncertain situations’; ‘Our organisation seizes opportunities quickly’; ‘Our organisation quickly manages to deploy and redeploy resources to support execution resilience’.

4.2.3 Leadership scale

As a scale of leadership , six items and one-dimensional scale which was validated by Donate and Guadamillas (2011) and Donate et al. (2023). Scale expressions are as following: ‘Leadership is creating an environment for a responsible behaviour of employees and work in teams’; ‘Managers are accustomed to assuming the role of knowledge leaders which it is mainly characterised by openness, tolerance to mistakes and mediation for the achievement of the firm’s objectives’; ‘Managers promote the acquisition of external knowledge’; ‘Managers behave as advisers, and controls are just an assessment of the accomplishment of objectives’; ‘Managers promote the acquisition of external knowledge’; ‘Managers reward employees who share and apply their knowledge’.

The scale choice comes from a conviction of the manager role to lead agile projects within organisations. This belief is supported by recent research on Generation Z of managers with values, principles, tools and skills promoting agility (Dobos et al., 2022).

4.3 Findings

4.3.1 Descriptive statistics and correlation analysis

The present research uses the R^2 criterion for the PLS model assessment (Hair et al., 2012). This index tests the cross-validation between the manifest variables of an endogenous latent one and the manifest variables set of the latent variables explaining the endogenous latent one using the estimated structural model (Tritah and Daoud, 2021). The calculated R^2 values for the endogenous latent variables are 0.397 for agility and 0.490 for leadership. They are positive, so the model has predictive validity (Fernandes, 2012). Besides, the goodness-of-fit (GoF) index of the structural model is 0.55 (> 0.36), which is considered to be large. This result validated that the structural model is proper with high predictive power (Wetzels et al., 2009).

Table 1 Measurement model reliability and convergent validity

Construct	Indicator	Loading	T-value	Alpha Cronbach	Rho-a	CR	AVE
Dg				0.954	0.957	0.963	0.813
	Dg1	0.912	74.682	0.943			
	Dg2	0.918	100.012	0.943			
	Dg3	0.889	59.891	0.947			
	Dg4	0.938	141.684	0.939			
	Dg5	0.879	52.061	0.946			
	Dg6	0.873	42.263	0.948			
Ag				0.876	0.916	0.909	0.667
	Ag1	0.889	101.728	0.835			
	Ag2	0.830	36.176	0.856			
	Ag3	0.886	89.098	0.826			
	Ag4	0.703	25.777	0.870			
	Ag5	0.761	33.818	0.859			
Ls				0.925	0.929	0.941	0.728
	Ls1	0.797	46.901	0.923			
	Ls2	0.876	73.531	0.905			
	Ls3	0.790	27.902	0.917			
	Ls4	0.883	60.333	0.902			
	Ls5	0.879	62.369	0.904			
	Ls6	0.888	85.135	0.903			

Notes: n = 347; Dg: digitalisation; Ag: agility; Ls: Leadership; CR: composite reliability; AVE: average variance extracted.

Confirmatory factor analysis results regarding the scales used in the study are shown in Table 1. The reliability is examined by Cronbach's alpha and by the composite reliability (Lacroux, 2011). They are acceptable between 0.5 and 0.6. These conditions have been verified for all constructs. The convergent validity is also checked. It indicates the adequacy of the correlation between the measurements and the construct. It is verified when the loadings expressing the factorial contributions exceed 0.5 and are significant

(Hair et al., 2017). This is confirmed when the variance between the construct and the measures (AVE: average variance extracted) exceeds 0.5 (Hair et al., 2017). The loadings are above this threshold, and are significant.

Then, discriminant validity allows knowing to what extent a concept is actually distinct from others according to empirical standards (Hair et al., 2016). To test the discriminant validity, the Fornell-Larcker criterion compares the square root of the mean variance extracted relative to each latent variable with its correlations with the other latent variables. In addition, cross-loading of different items is used. The discriminant validity of the measurement instrument is confirmed by the Table 2.

Table 2 Discriminant validity

	<i>Dg</i>	<i>Ag</i>	<i>Ls</i>
Fornell-Larcker criterion			
Dg	0.902		
Ag	0.629	0.817	
Ls	0.701	0.631	0.853
Cross-loading evaluation			
Dg1	0.912	0.638	0.645
Dg2	0.918	0.593	0.685
Dg3	0.889	0.527	0.647
Dg4	0.938	0.558	0.659
Dg5	0.879	0.535	0.558
Dg6	0.873	0.546	0.584
Ag1	0.618	0.889	0.636
Ag2	0.500	0.830	0.551
Ag3	0.495	0.886	0.597
Ag4	0.457	0.703	0.310
Ag5	0.497	0.761	0.360
Ls1	0.676	0.529	0.797
Ls2	0.588	0.610	0.876
Ls3	0.498	0.409	0.790
Ls4	0.625	0.559	0.883
Ls5	0.618	0.537	0.879
Ls6	0.562	0.562	0.888

4.3.2 Bootstrap regression analysis

The hypotheses were tested by the PLS approach of the structural equations. The regression analysis based on the bootstrap method was used to test the hypotheses constructed. Findings related to the regression analysis performed for this purpose are given in Table 3.

Table 3 Evaluation of the structural model

	<i>Path</i>	<i>β-standardise estimate</i>	<i>t-value</i>	<i>Bootstrap (standard deviation)</i>	<i>Validation of hypotheses</i>
H1	Dg→Ag	0.785***	58.558	0.013	Confirmed
H2	Dg→Ls	0.701***	30.053	0.023	Confirmed
H3	Ls→Ag	0.631***	17.842	0.035	Confirmed
H4	Dg→Ls→Ag	0.443***	13.380	0.033	Confirmed

Note: ***p < 0.001

To begin with, the first hypotheses of the research; direct effects were tested to determine the effect of digitalisation on organisational agility. Then, we tested the direct effect of digitalisation on leadership and the direct effect between leadership and organisational agility. Regression analysis results showing that digitalisation has a positive and significant influence on agility ($\beta = 0.785$; $t = 58.558$) and leadership ($\beta = 0.701$; $t = 30.053$). This result supports the proposed hypothesis H1 and H2. It is consistent with previous work, arguing that agility and digital transformation are interconnected (Giacosa et al., 2022). The empirical study demonstrates that leadership has a significant and positive influence on agility ($\beta = 0.701$; $t = 30.053$). Therefore, H3 is supported. The t-value result relating to the hypothesis linked to the mediation impact is significant and once again confirms the validity of the proposed hypothesis H4.

5 Discussion and results

One of our research main objectives is to value the relationship between digitalisation and organisational agility. In this context, the literature review allows us to put forward a first main hypothesis positively linking the two variables. This observation confirms the results found in previous studies. Our empirical study led to the confirmation of this central hypothesis. In fact, our findings confirmed studies by Lee et al. (2015), Overby et al. (2006) Roberts and Grover (2012), and Rubino et al. (2023). Moreover, in the digital age, organisations are faced with increasingly turbulent environments. This invites organisations to understand in detail the relationship between their information systems and organisational agility so that they can invest in and configure the most appropriate types of technologies.

Digitalisation offers opportunities and challenges for businesses (Antikainen et al., 2018). It provides tools and requires competences (Konttila et al., 2019). In the current literature managers focused on technology have capacities to amplify the relationship between digitalisation and organisational agility. Cooper et al. (2000) show that communication technologies can develop the decision -making agility. Indeed, decision-making technologies have a large category of applications, technologies and processes for the collection, storage, access and data analysis. They help managers in making the best decisions. However, investment in technological infrastructure is insufficient to develop organisational agility. Organisations need a leadership style offering a favourable environment to learning new technologies, which increases the level of confidence and technological competence among employees (Weng et al., 2014;

Srivastava and Dhar, 2016; Jäckli and Meier, 2020). Our statistical analyses lead to the confirmation of the leadership mediating effect on the link between digitalisation and organisational agility. We agree with previous research namely Markus (1983), Cooper et al. (2000), Wixom and Watson (2001), Park et al. (2017), who show that technology-focused managers have capabilities influencing the relationship between ICT and organisational agility. Also, our results join the contribution of Daft and Lengel (1986) affirming that the leadership style centred on technologies has the capacity to interpret the information brought by the business intelligence technologies and the communication technologies in order to make strategic decisions. Companies have to be highly responsive to react and very flexible to adjust. Responsiveness is supported by technologies, informations and leaded human resources. Thus, leadership is designed as an organisational factor that determines the digitalisation adoption way on organisations (Wixom and Watson, 2001). The Research Findings claims that digitalisation has a positive effect on organisational agility. Besides the leadership, this digitalisation is an essential antecedent of organisational agility.

Theoretically, our results highlight the interaction between digitalisation and agility by contributing to the literature flows. The present work offer new perspectives and expands the body of knowledge by explaining in more detail the relationship between the three studied variables, namely digitalisation, agility and leadership. The research supports existing theories on the features of leadership which promote agility in a digital age. Indeed, it is not ICT in themselves that can enable organisations to become agile, but rather the way of their use and combination with other factors. The paper propose a new mediated model in which agility depend on digitalisation and leadership style. In a managerial way, the findings are based on 347 valid surveys collected from highly qualified managers. They are well grounded in the reality of businesses and decision making. The results should encourage companies to adopt digital tools in the actual volatile business environment to ameliorate agile capabilities. To become agile, companies might launch digitalisation projects and develop new digital tools. The adoption of new digital tools depends on the exercise of leadership within a managed team. Managers might develop and experiment a new digital tools. In this regard, our study provides an answer that helps managers make pragmatic decisions regarding investment in digitalisation. Our work invites managers to understand the specificities of their work context and to be vigilant and attentive in order to interpret and make sense of what technologies report.

This research is not vacant in limitations. We use non-probability sampling, which constitutes a relative obstacle to the result generalisation. Besides, we used a cross-sectional data which could prevent the causality deduction. We do not take company size into account in our model. Indeed, several studies show that the company's size impact agility differently. Future research might use size as a control variable between digitalisation and organisational agility. Likewise, the study does not assess whether the companies in our sample have a low or advanced digitalisation degree. Farther studies could investigate these points. To conclude, there are many research prospects on the subjects of numerical, agility and leadership. This study encourages researchers to go further by detailing their aspect and by applying new empirical models.

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