

STRATEGIC ORIENTATION: PERSPECTIVE OF DIGITAL LEADERSHIP AND INNOVATION

Oleh :

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Informasi Artikel

Riwayat Artikel :

Submit, 3 Maret 2026

Revisi, 6 April 2026

Diterima, 27 April 2026

Publish, 15 Mei 2026

Kata Kunci :

Digital Leadership,
Digital Entrepreneurship Orientation,
Exploratory Innovation.



ABSTRACT

Recent research on leadership underscores digital leadership has a role to play in encouraging innovation within MSMEs. However, a gap persists in the previous research the presence and influence of digital leadership. To address this, our study integrates the resource-based approach and social information processing theory for explore how digital entrepreneurial orientation shapes the relationship between digital leadership and exploratory innovation. Through phased data collection from 200 employees and 20 leaders, our results indicate that (a) digital leadership positively influences exploratory innovation, and (b) digital entrepreneurial orientation serves as a mediator in this relationship. This research not only advances the field of organizational digitalization but also deepens the understanding of how digital leadership connects to exploratory innovation. The findings offer significant theoretical contributions to the field of leadership studies and practical recommendations for industry practitioners.

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1. INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) form a fundamental structural component of Indonesia's financial architecture, significantly influencing the nation's Gross Domestic Product (GDP). In 2015, MSMEs accounted for a staggering 99.98% of business entities, wherein they contributed 57% to Indonesia's GDP while engaging over 97% of the local workforce. Fast-forward to 2020, these enterprises' contribution to Indonesia's GDP soared to 61%, with the employment rate of domestic labor hitting 97%. The updated data illustrate that as of 2022, MSMEs represent 61.1% of Indonesia's GDP, juxtaposed against the meager 38.9% contribution from merely 5,550 large-scale businesses, representing a minuscule 0.01% of the total business participants. Among the 61.1% contribution from MSMEs to Indonesia's GDP, a dominant proportion

comes from micro-entrepreneurs, which comprised approximately 98.68% and employed nearly 89% of the workforce. This highlights the considerable economic footprint of MSMEs on the Indonesian economic terrain, demonstrating a promising prospect for the formation of a robust national economic landscape, primarily owing to the significant number of MSMEs, particularly at the micro level, with their extensive employment generation capacity (Anatan & Nur, 2023). While scholarly investigations encompass the realms of digitalization and sustainability (Denicolai, Zucchella, & Magnani, 2021; Priyono, Moin, & Putri, 2020), the comprehension of obstacles impeding Sustainable Digital Transformation (SDT) for MSMEs remains notably sparse. This gap holds considerable importance because, for MSMEs to navigate their path towards sustainability

successfully, they must surmount various hurdles and judiciously choose relevant digitalization strategies aligned with the guiding principles of digital transformation (Rupeika-Apoga & Petrovska, 2022).

Disruptive digital technologies (Karimi & Walter, 2015) have propelled the expansion of the global digital landscape at an unprecedented pace. Organizations often face challenges in digitalization, particularly within uncertain, volatile, complex, and ambiguous (VUCA) environments (Wang, Lin, & Sheng, 2022). In fact, the success rate of corporate digital transformation remains below 30%, emphasizing the critical role of assistance and leadership from middle and executive managers in ensuring its success (L. Mihardjo, Sasmoko, Alamsyah, & Djap, 2019; Oberer & Erkollar, 2018). Digitalization has reshaped leadership characteristics and performance by enabling real-time access to vast data pools (Noble & Mazzei, 2017), introducing new communication paradigms (Bennis, 2013), transforming leadership education approaches (Soh, Sia & Weill, 2016), and enhancing decision-making through advanced data analytics. Additionally, digitalization has given rise to new leadership positions, such as Chief Technology Officers (CTOs) and virtual teams (Nadkarni & Prügl, 2021; Schwarzmüller, Brosi, Duman, & Welp, 2018). These transformations necessitate an adaptive and continuous approach to leadership, known as digital leadership (Kane, Anh, Phillips, & Garth, 2019). Digital leadership revolves around five key competencies: creativity, reflective thinking and innovation, curiosity, deep expertise, and a global perspective combined with collaborative engagement (Zhu, 2015; Schweitzer, 2014).

Although the MSME sector and consulting industry have embraced digital leadership often referred to as Leadership 2.0 (Hesse, 2018), academic research on this critical phenomenon still in the early stages. The existing body in research stage recognizing the significance of digital leadership is steadily expanding. In general, studies on digital leadership explore its foundations, principles, and characteristics, often touching on themes pertaining to digital transformation, online technologies, frameworks, and organizational dynamics. Additionally, early research has begun to establish a connection the connection between digital leadership and adaptability capabilities (L. Mihardjo et al., 2019), innovation management (Wasono & Furinto, 2018), market orientation (L. W. W. Mihardj, nananaa, deyelidahdandyandyeyelidah, & Elid variables. Although understanding of the importance and the role of digital leadership in driving digital transformation and innovation continues to grow, the outcomes available in the literature remain fairly limited, and there is a dearth of high-quality research (Wang et al., 2022).

This study aims to fill the gap several research gaps in the field of digital leadership. (1) As digitalization is a relatively recent phenomenon, most existing research has primarily examined internal processes and strategic approaches. Limited studies have explored the digitalization of organizational management, and an even smaller number have investigated the role of digital leadership in corporate digital transformation (Gfrerer, Rademacher, & Dobler, 2021; Philip, 2021). Consequently, discussions on the resulting variables of digital leadership remain scarce. Our study examines this emerging leadership style digital leadership within the context of digitalization, revealing its significant influence on MSME innovation and the formation of digital entrepreneurial orientation. This contribution enhances the understanding digital-based leadership outcomes within organizations and highlights the role of individuals in digital transformation. (2) Although Mihardjo et al. (2019) have established that digital leadership fosters MSME managing innovation, the specific process and trajectory remain largely unexplored. Given the rapid market and technological evolution in the digital era, corporate survival and growth increasingly depend on disruptive exploratory innovations rather than general MSME innovations. However, an empirical framework linking digital leadership to exploratory innovation has yet to be developed, leaving the variables involved in this relationship unclear. To address this gap, we develop an empirical framework on digital leadership and exploratory innovation and identify digital entrepreneurship approach as a mediating factor (Wang et al., 2022). (3) Previous studies have proven that several styles of leadership, such as strategic leadership (Pasaribu, Bulan, Muzakir, & Pratama, 2021; Simsek, Jansen, Minichilli, & Escriba-Esteve, 2015), transformational leadership (Chen, Sharma, Zhan, & Liu, 2019), fair and inclusive leadership (Gong, Liu, Rong, & Fu, 2021), participative leadership (Chang, Hodgkinson, Hughes, & Chang, 2019), and distributed leadership (Berraies, Hamza, & Chtioui, 2021), demonstrates positive impact on exploratory innovation. Despite this valuable contribution, critical gaps persist in the literature that must be completed for further theoretical and empirical advancements. Digital leadership represents a key development in this domain. By emphasizing its pivotal role in MSME innovation, this study expands the scope of leadership styles that impact exploratory innovation.

This study examines the mechanisms and pathways through how digital leadership supports exploratory innovation. To accomplish this, we build upon the digitalization research of Nadkarni and Prügl (2021) and Oberer and Erkollar (2018) incorporating both human elements (organizational management) and technological/material aspects of updates in business management. By integrating based on resource theory (RBV) and social

information processing (SIP), this study offers a new perspective on strategic orientation in digital leadership. While RBV is driven by rapidly evolving market demands, SIP highlights the significance of motivation and employee engagement. Specifically, RBV serves as a framework for understanding how digital leadership cultivates a digital entrepreneurial orientation, thereby fostering exploratory innovation by encouraging firms to experiment with and adopt novel strategies (Kollmann & Stöckmann, 2014). Meanwhile, from an SIP standpoint, the attitudes and behaviors of organizational members are influenced by the cues and information from digital leadership concerning organizational support and behavioral expectations. Over time, this mindset and cultural orientation become embedded within the organization through social interactions. In this context, digital entrepreneurial orientation acts as an intermediary in the relationship between digital leadership and exploratory innovation. Ultimately, this study enhances the understanding of the pathways linking digital leadership to exploratory innovation.

Theory and hypotheses

Digital leadership

The study of digital leadership is grounded in Hambrick & Mason's (1984) upper echelon theory, as discussed by (Wasono & Furinto, 2018). This theory posits that a leader's experiences, values, and personality traits shape their decision-making (Hambrick, 2007) and, in turn, impact organizational effectiveness (Hambrick & Mason, 1984). Over time, it has evolved into an essential framework for analyzing how leadership traits and experiences shape perceptions, influence decisions, and guide actions that affect various MSME outcomes (Neely, Lovelace, Cowen, & Hiller, 2020). The theory has been widely implemented in different leadership types, such as entrepreneurial-based leadership (Mehmood, Jian, Akram, Akram, & Tanveer, 2022) and strengthen leadership (Ou et al., 2014). Digital leadership, as a distinctive leadership style, endows leaders with unique traits and decision-making approaches, ultimately affecting firm-level outcomes. Although interest in digital leadership has grown in recent years, a universally accepted definition has yet to emerge. Two primary perspectives dominate the discourse. The first, presented by Waal et al. (2016), digital leadership as the convergence of digital technologies and transformational leadership, emphasizing a leader's capability to recognize and leverage opportunities that generate Benefits through efficiency and ethical utilization of digital tools. The second, proposed by Mihardjo et al. (2019; 2019), defines digital leadership as part of digitalization competencies into leadership practices to enhance firm value. Expanding on this, Sawy et al. (2016) introduced business environment perspective, suggesting that digital leadership involves executing the right strategic actions to drive digital

transformation within an organization and its broader business network. Further refining this concept Oberer and Erkollar (2018) designing two aspects Industry 4.0 leadership style matrix. In this model, the x-axis represents an individual's capability, emphasizing technology and innovation orientation, while the y-axis reflects a leader's concern for people. This matrix categorizes leadership into four distinct styles include TL (4.0 Technology Leader), DL (4.0 Digital Leader), EL (4.0 Social Leader), and FL (4.0 Freshmen Leader) (Wang et al., 2022).

Existing research offers extensive discussions on the traits and competencies associated with digital leadership, with Zhu (2015) study being among the most notable and impactful. Zhu (2015) identifies five key characteristics that define digital leadership. This research on digital leadership is based on Mason and Hambrick (1984) "upper echelon" theory, as described by Furinto & Wasono (2018). The essence of this theory lies in the influence of a leader's experience, values, and personality in determining their choices (Hambrick, 2007), which subsequently affects organizational performance (Mason & Hambrick, 1984). This theory has inspired research on how leaders' traits and experiences influence their perceptions, decisions, and behaviors, all of which Ultimately it has a diverse impact MSME outcomes (Neely et al., 2020). It has been applied across different leadership types, including entrepreneurial-based leadership (Mehmood et al., 2022) and empowering leadership (Ou et al., 2014).

Adopting a leadership approach that focuses on leveraging digital technologies to drive innovation and organizational success equips leaders with distinctive traits and capabilities that shape their behaviors and decision-making, ultimately influencing company-level outcomes. While interest in digital leadership has grown in recent years, despite extensive research and discussion on the topic, a universally accepted definition has yet to be established. Two primary perspectives define digital leadership: first, Waal et al. (2016), describe it as the intersection of transformational leadership and digital technology, emphasizing a leader's ability to identify and seize opportunities to create value through the efficient, effective and widely accepted use of digital tools. Second, Mihardjo et al. (2019; 2019), define digital leadership as the integration of digital competencies into leadership approaches to drive value creation within a company. Expanding on this, Sawy et al. (2016) introduce the business ecosystem perspective, arguing that digital leadership involves executing the right strategic actions to ensure successful digital transformation for both the company and its broader ecosystem. Building on these ideas, Oberer & Erkollar (2018) Created a dual-dimensional leadership style framework for the industry 4.0 era. In this framework, the x-axis represents technological and innovation-oriented capabilities, while the y-axis reflects a leader's

attentiveness to people. This model classifies leadership into four distinct styles: TL (Technology Leader 4.0), DL (Digital Leader 4.0), EL (Social Leader 4.0), and FL (Fresh Leader 4.0) (Wang et al., 2022).

The literature extensively discusses the traits and competencies of digital era leadership, with Zhu (2015) being one of the most influential scholars in this domain. Zhu (2015) identified five key characteristics of digital leadership: (1) as digital leaders must possess deep expertise and a strong grasp of learning and change processes; (2) as creative leaders, they need an innovative mindset and the ability to transform future-oriented ideas into business realities; (3) as leaders with a global vision, they must provide direction and drive digital business transformation; (4) as curious leaders, they should demonstrate a strong capacity for learning and applying digital capabilities; and (5) as profound leaders, they must leverage their extensive knowledge and deep understanding in decision-making. These attributes primarily focus on a leader's skills. Waal et al. (2016) expanded on this concept, defining digital leadership as a blend characteristics and skills that enable leaders to influence and motivate others to perform effectively, with digital communication competency playing a crucial role (Schiuma, Schettini, Santarsiero, & Carlucci, 2021). Imran et al. (2020) further examined the foundation competencies that set digital leaders apart, identifying five essential skills: digital vision, rapid experimentation (fast failure), digital knowledge, empowerment, and diverse team management. His study broadened the understanding of digital leadership by examining it from both the leader's perspective and the leader-follower interaction, providing valuable insights. Additionally, Bennis (2013) emphasized that digital leaders must exhibit adaptability, resilience, and openness to innovation. McCarthy et al. (2021) and Putritamara et al. (2023) explored leadership within the context of digital transformation, introducing the concept of "digital transformation leadership." They outlined eight key attributes of leaders in digital transformation: digital strategist, digital architect, digital culturist, customer-centric mindset, organizational agility, data advocacy, business process optimization, and digital workplace engagement (Wang et al., 2022).

Exploratory innovation

Management within the sphere of innovation can be primarily classified into two distinct sectors: exploratory innovation and incremental innovation. The former is characterized by the assimilation and practical application of newfound knowledge to conceive entirely fresh products or services. Such products and processes are designed for emerging markets or novel customer demographics (Wasono and Furinto, 2018; Sheng and Chien, 2016). This undertaking presents a significant degree of novelty,

leading to altering the established hierarchy, which is often perceived as a skilled strategy to foster competitive supremacy (Sheng & Chien, 2016). Conversely, incremental innovation is associated with the augmentation of pre-existing knowledge to upgrade established products, services, processes, or models (Nguyen, Lei, Vu, & Le, 2019; Sheng & Chien, 2016). It exhibits characteristics of reduced novelty, cost, and risk and is typically tied to minor modifications (Lei, Ha, & Le, 2019).

Exploratory innovation, when compared to its incremental counterpart, is more intricate, as it needs a more extensive resource foundation, incurring higher costs and risks. However, it exhibits a higher potential to seize fresh market potentials and accentuate its benefits in the digital epoch. Consequently, for a company's sustainability and growth, exploratory innovation assumes greater significance (Lumpkin & Dess, 2001). Our objective is to offer a multifaceted platform for extensive research endeavors dedicated to groundbreaking innovation.

Digital leadership and exploratory innovation

Digital leadership significantly contributes to driving exploratory innovation by enabling organizations to adapt to change and promote innovation. According to Wasono & Furinto (2018), digital leaders are instrumental in expediting decision-making and facilitating transformation, particularly in the adoption innovation and digital technologies. Digital leadership integrates the MSME strategy with IT strategy, forming a unified digital business strategy. Four key dimensions define a digital business strategy: its scope, scale, speed of execution, and value creation sources (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013).

Innovative and forward-thinking digital leaders possess a deep awareness of the significance of exploratory innovation. They actively cultivate it as a key aspect of digital business strategy, strategically fostering its enterprise-wide implementation through a top-down approach. Additionally, digital leaders champion the seamless and efficient integration of digital tools across various departments (Borowska, 2019), increasing internal automation and smart systems workflows (e.g., office suite software) to optimize operational effectiveness and enhance managerial effectiveness. This transformation frees team members from repetitive tasks, allowing them to concentrate on higher-order thinking tasks. Moreover, these advancements reshape social network structures with customers and suppliers, creating new chances to delve into innovative value-creation methods. As a result, organizations experience substantial transformations in their products, services, structures, and business models. With this perspective in mind, we propose Hypothesis 1 as a foundational step in our study to examine the correlation between digital

leadership and exploratory innovation as a key driver of MSMEs' advancement in the digital era.

Hypothesis 1: Digital leadership positively influences exploratory innovation.

Digital entrepreneurial orientation as a mediator

In today's digital era, where the business environment is constantly evolving, the entrepreneurial mindset is no longer limited to a specific group to startups. Established companies must also embrace entrepreneurial activities and foster an entrepreneurial mindset to generate added value. Entrepreneurial orientation reflects a company's ongoing commitment to navigating business uncertainties while continuously seeking new opportunities through entrepreneurial endeavors. As a key aspect of strategic orientation, it embodies an organization's entrepreneurial spirit and readiness to participate in entrepreneurial endeavors (Kollmann & Stöckmann, 2014). Entrepreneurial orientation is generally characterized by three core dimensions: innovation, proactivity, and risk-taking (Covin & Slevin, 1991; Miller, 1983). Innovation signifies a company's openness to novel ideas, experimentation, and the pursuit of innovation. Proactivity involves anticipating future market demands and trends, taking early action to gain a first- competitive edge gained by early movers. Risk-taking pertains to inclination to engage in high-risk initiatives and make bold decisions despite uncertain outcomes.

Expanding upon the notion of eco-friendly entrepreneurial mindset, we suggest that digital entrepreneurial orientation represents a continuation regarding entrepreneurial orientation in the digital sphere. It represents a company's ongoing commitment to leveraging applying digital tools in business ventures to manage business uncertainties and consistently explore new opportunities. Unlike traditional entrepreneurial orientation, digital entrepreneurial orientation not only incorporates innovation, proactiveness, and risk-taking but also emphasizes responsive market agility. This is due to the rapid and cyclical nature of changes in digital products and services. To effectively adapt to evolving customer needs, organizations must adopt an agile and lean approach, ensuring greater efficiency and responsiveness in the development of innovative goods and offerings.

Digital leadership drives exploratory innovation by cultivating a digital entrepreneurial mindset. The Resource-Based View (RBV) is a widely acknowledged model for analyzing how organizations attain and preserve competitive advantages by strategically utilization of their resources (Barney, 2001). According to RBV, a firm's competitive edge depends on resources that are valuable, non-substitutable, difficult to imitate and rare (Barney, 1991). Strategic orientation serves as a key driver in changing these resources into value. RBV underscores the importance of entrepreneurial orientation, requiring leaders to develop resources

that enhance innovation, proactiveness, risk-taking, and agility while leveraging external insights to encourage innovative behaviors. Lumpkin & Dess (2001) highlighted that entrepreneurial orientation enables businesses to create brand-new resource combinations (Liu & Lee (2019); Kollmann & Stöckmann, 2014) further asserted that an entrepreneurial approach is a key intangible asset that strengthens strategy execution and fosters innovation, making it tough for industry rivals to recognize, replicate, or emulate. Digital entrepreneurial orientation embodies leadership mindset regarding transformation, innovation, calculated openness to risk, and market competition. Digital leaders are tech savvy, adaptable, and forward-thinking, possessing the ability to rapidly assimilate emerging technologies and effectively mobilize both external and internal resources such as R&D investments and expert analysts to maintain an innovative edge. These leaders also exhibit a strategic vision, a proactive decision-making approach, and the ability to act decisively even with incomplete information (Schiuma et al., 2021). Such qualities enable organizations to seize opportunities promptly, reinforcing their risk-taking and proactive stance. Moreover, digital leaders exhibit deep insights into market and trend awareness, business intelligence, problem-solving capabilities, and the resilience to learn quickly from failures, fostering an agile corporate culture that develops or acquires distinctive competitive resources.

Isichei et al. (2020) asserted that digital entrepreneurial orientation positively influences a company's innovation. Innovation drives organizations to embrace through experimentation, pioneering technological advancements, and investment in innovation and development entities can innovate by developing new products, processes and services. (Bhuiyan, Menguc, & Bell, 2005). These capabilities allow firms to develop new product-market combinations and adopt cutting-edge technologies, methodologies, and processes to enhance their offerings (Kollmann & Stöckmann, 2014). Being proactive encourages businesses to recognize and capitalize on emerging opportunities, take initiative, and anticipate future demands, helping them break free from managerial inertia and conventional practices (Tang, Kacmar, & Busenitz, 2012), This proactive stance enables companies to develop resources more efficiently and cost-effectively than competitors (Lumpkin & Dess, 2001) positioning them as industry leaders. Risk-taking entails the willingness to commit substantial resources, accelerate decision-making, and seize opportunities rapidly, making it a key factor for companies engaged in exploratory innovation, as they often embrace economic and commercial uncertainties (Kollmann & Stöckmann, 2014). Agility, by comparison reflects a company's ability to swiftly identify user needs, dynamically allocate

resources, and efficiently optimize resource utilization to redefine markets, customer relationships, and business models. This adaptability ensures that groundbreaking products and services align with and anticipate emerging user demands. Based on this understanding, we put forward the following hypothesis:

Hypothesis 2: The relationship between digital leadership and exploratory innovation is positively influenced by digital entrepreneurial orientation as a mediating factor.

Impact pathway map

Research on this impact pathway draws on the perspectives of Nadkarni & Prügl (2021) and Oberer and Erkollar (2018). These scholars indicate that digital leadership significantly affects both personnel agents (in terms of organizational management) and the innovation of materials and technologies (pertaining to business management). Building on the Structural Influence Process (SIP) and Resource-Based View (RBV), we propose that exploratory innovation necessitates a reconsideration of a company's strategic orientation within business management in the context of organizational management. Digital leaders must effectively address both external market dynamics and internal organizational needs. As a result, they should emphasize fostering a digital entrepreneurial orientation by actively engaging in exploration and risk-taking within business operations. To represent this connection, we construct a pathway diagram with the influence on corporate management along the coordinate axis and the influence on business management along the y-axis, illustrating how digital leadership promotes exploratory innovation, as presented in Figure 2.

Digital leadership enhances exploratory innovation through three key pathways: First, digital leaders drive transformations in organizational management by fostering internal conditions that encourage member engagement and creativity. This cultivates a dynamic interaction between individuals and innovation, ultimately advancing exploratory innovation behaviors. Secondly, digital leaders restructure business management to cultivate a digital entrepreneurial mindset, driven by shifting market demands, prompting companies to accelerate their exploratory innovation efforts with greater speed and agility. Ultimately, digital leaders drive transformative changes in both organizational and business management. Equal emphasis is placed on the digitalization of both products and key stakeholders. The collective influence of digital entrepreneurial orientation further strengthens exploratory innovation initiatives.

Figure 1 presents the theoretical model, below.

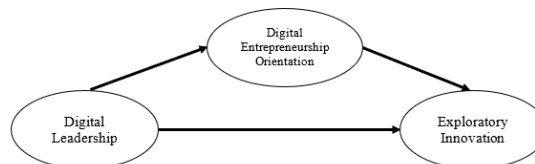


Figure 1. Hypothesized Theoretical Model

2. METHODS

In this study, we employed a systematic approach to assess variables that we have identified using measurement scales widely recognized in academic research literature. The research inquiries were designed for exploration and reliability, assessment using empirical approaches with large data samples. For our data analysis, the software tools SPSS version 23.0 and Smart-PLS version 4 were utilized as the primary resources. We conducted hypothesis testing by applying structural equation modeling and bootstrapping techniques, both of which are better suited to the specific needs of our study, as suggested by McAlister (2016). Thus, we are confident that we have selected the most appropriate methodology that aligns with the scope and specific challenges encountered in our research.

Measures and variables

In this research, all elements were evaluated using a five-point Likert scale, with answer choices spanning from 1 ("strongly disagree") to 5 ("strongly agree"). The assessment of digital leadership followed the framework developed by Zhu (2015), which includes five key dimensions: creativity, analytical thinking, curiosity, deep expertise, and a global perspective with collaboration. This scale has been widely applied in various empirical studies, contains several items. We consolidated similar items into a 5-item scale, boasting high reliability and validity as demonstrated by alpha = 0.980, CR = 0.980, AVE = 0.925.

To measure digital entrepreneurial mindset, comprising innovative, proactive, and risk-taking dimensions, we adopted and adapted a 4-item scale from Miller (1983) and Covin & Slevin (1991). For the agility dimension, we employed a 3-item scale concerning market agility from Lu & Ramamurthy (2011), bringing the total digital entrepreneurship orientation items tested to 4 (alpha = 0.970, CR = 0.972, AVE = 0.917).

Building upon and refining the scale developed by Zhou and Wu (2010), while also drawing insights from Tuncdogan et al. (2017) on exploratory innovation, we designed a six-item scale by identifying commonalities among selected items (alpha=0.906, CR=0.910, AVE=0.683).

Table 1. Convergent Validity

Constructs	Items	Loadings	Alpha	CR	AVE
Digital Leadership (DL)	DL1	0.964	0.980	0.980	0.925
	DL2	0.965			
	DL3	0.967			
	DL4	0.957			
	DL5	0.956			
Digital	DEO1	0.963	0.970	0.972	0.917

Entrepreneurial Orientation (DEO)	DEO2	0.967			
	DEO3	0.961			
	DEO4	0.939			
Exploratory Innovation (EI)	EI1	0.837	0.906	0.910	0.683
	EI2	0.913			
	EI3	0.721			
	EI4	0.764			
	EI5	0.822			
	EI6	0.886			

Note: CR: Composite Reliability, AVE: Average Variance Extracted

This study also considered the age of among executives, staff members, and companies as control variables. This stems from the finding that a leader's age can influence their work attitudes, values, and managerial styles, whereas a company's age affects innovation. In addition, younger and older employees react differently to leaders' behaviors and capacity to accept digital change. The actual ages of leaders and employees were recorded, whereas a company's age was evaluated through the natural logarithm of its founding year.

From the valid data, the youngest leader's age was 44 and the oldest was 59. The youngest employee was 20 years old, and the oldest was 59. Most of the MSMEs were aged between >3-5 years, constituting 50.0%. Considering the distribution across industries, foods and beverages accounted for 51.17%. These businesses range from traditional food stalls to modern restaurants. These were followed by handicrafts and handmades (25.56%). Culinary businesses are very popular in Indonesia because food and beverages are the basic needs of people. With a more friendly language adjustment and neat structure, the above explanation effectively summarizes the concepts and methodology of the research in a clear and informative manner while maintaining professionalism. This ensures that readers gain a comprehensive overview of the study with ease and precision.

3. RESULT AND DISCUSSION

Common method bias

In an effort to mitigate common methodological biases, this research not only gathered questionnaires in multiple phases but also employed a dual-source data approach by pairing leader and employee responses while applying Harman's single-factor test to the dataset. The analysis showed that three factors accounted for 56.525% of the total variance, with the first unrotated factor explaining 59.222%, this value stays below the 40% threshold. Furthermore, a confirmatory factor analysis confirmed that the five-factor model performed better than alternative models, suggesting that method bias was not a major issue in this study.

Descriptive statistics and correlation

Table 1 displays the results of the descriptive statistical analysis was conducted, encompassing the mean, standard deviation, and correlation coefficients for each variable, obtained using SPSS (version 23.0). The findings indicate that the key variables exhibited significant correlations with one another, with all

correlation coefficients being below 0.7, thus generally aligning with the hypotheses regarding correlations among core variables.

Measurement model

The smallest standardized loading for each scale exceeded 0.6, while the lowest Composite Reliability (CR) value was greater than 0.7, and the minimum Average Variance Extracted (AVE) surpassed 0.5. To ensure content validity, widely recognized scales were selected, revised, and refined multiple times. As shown in Table 2, the discriminant validity analysis verified the five-factor model satisfied the necessary criteria and was identified as the most suitable fit. Additionally, the Heterotrait-Monotrait Ratio (HTMT) test was conducted to further assess discriminant validity. This method calculates the average correlation ratio between constructs in relation to the geometric mean correlation within the same construct (Voorhees, Brady, Calantone, & Ramirez, 2016). The results demonstrated that the highest HTMT value among any three factors was 0.675, remaining below the 0.8 threshold, confirming that the sample data exhibited strong discriminant validity.

Table 2. Heterotrait-Monotrait Ratio (HTMT)

	DEO	DL	EI
DEO			
DL	0.580		
EI	0.528	0.675	

Structural model

The path analysis results reveal that the pathway coefficient linking digital leadership to digital entrepreneurial orientation is 0.568 ($p = 0.000$) and to exploratory innovation is 0.640 ($p = 0.000$). To test the hypotheses, the primary effects, mediation effects, bootstrapping was utilized to analyze the total effects and relationships among the variables in the theoretical model, with 5,000 samples. As shown in Table 3, the test results confirm that the connection between digital leadership and exploratory innovation is significant ($\beta = 0.640, p = 0.000$), thereby fully supporting H1.

Table 3. Bootstrapping effect analysis

	β	t	p-value
Direct effect			
Direct 1	0.640	15.119	0.000
Indirect effect			
Mediate 1	0.113	2.515	0.012

Note: Mediate 1 represents the indirect effect of digital entrepreneurial orientation.

Mediation Model Test

Next, additional standard deviation was applied to and deducted from the mean mediating capability to evaluate how digital entrepreneurial orientation influences the relationship between digital leadership as the predictor variable and exploratory innovation as the dependent variable. The results, shown in Table 3, indicate that the mediating effect concerning digital entrepreneurial orientation is significant ($\beta = 0.113, p = 0.012$), providing support for H2.

Discussion and conclusions

During the past decades, the theory of leadership has evolved significantly. Modern leadership theories extend beyond just the leader, incorporating the role of followers and the broader work environment. As digitalization accelerates worldwide, leadership is required to be more collaborative, relational, strategic, globally oriented, and adaptable (Larjovuori, Bordi, & Heikkilä-Tammi, 2018). Rather than merely exerting authority, leaders are expected to engage, actively listen and participate (Schwarz Müller et al., 2018). Many scholars have explored traits of digital leadership and the definition, reaching a consensus that it revolves around five essential competencies: creativity, critical thinking and analysis, curiosity, profound expertise, and a global perspective on collaboration (Zhu, 2015).

In today's fast-paced, unpredictable, and increasingly complex business landscape (Schiuma et al., 2021), organizations must be equipped to navigate unforeseen challenges and evolving scenarios. To remain competitive, they must embrace transformation and adapt their strategies to turn obstacles into opportunities for growth. A critical question arises regarding how leaders can manage their organizations toward exploratory innovation in the digital era. However, to the best of our knowledge, existing research has yet to examine the link between exploratory innovation and digital leadership remains underexplored. Thus, this study strives to resolve this gap by empirically examining this relationship.

This research leverages the Resource-Based View (RBV) and Socio-Cultural Institutional Perspective (SIP), using staggered survey findings from 200 employees and 20 leaders to analyze the way digital leadership affects digital entrepreneurial orientation and, in turn, stimulates exploratory innovation. Our findings offer key insights into how digital leadership integrates business and IT strategies to formulate a unified digital business strategy that emphasizes exploratory innovation. Moreover, digital leadership promotes the adoption and effective use of digital tools within organizations while strengthening human-machine collaboration. As a result, motivation, employees gain the time and resources needed to participate in more innovative tasks and explore new opportunities.

A distinctive contribution of this study lies in its exploration of how digital entrepreneurial orientation bridges the link between digital leadership and exploratory innovation. Mihardjo et al. (2019) recognized the substantial influence of digital leadership on MSMEs' innovation management but did not clarify the defined pathways and operational mechanisms. To further this research, it is essential to explore mediating variables from a suitable perspective. With this goal in mind, we expand upon the insights of Nadkarni & Prügl (2021) and Oberer

& Erkollar (2018) regarding by examining the distinction between actor and material dimensions in digitalization research, this study identifies digital entrepreneurial orientation as a mediating factor between digital leadership and exploratory innovation, utilizing the RBV and SIP frameworks.

In particular, from an RBV perspective, digital leadership supplies the essential resources for cultivating digital entrepreneurial orientation. This orientation serves as a distinctive resource that inspires a company to bolster exploratory innovation unabashedly when faced with potential opportunities. In contrast, from the SIP perspective, digital leadership provides valuable environmental cues to their followers. Digital leaders communicate to them about the digital vision and information while providing them with entitlement, trust, tolerance, and respect.

Significantly, the link between digital entrepreneurial orientation and digital leadership remains largely unexplored. This research contributes by examining how digital leadership influences digital entrepreneurial orientation, which acts as a key mediator between digital leadership and exploratory innovation. By investigating this mediating effect, the study provides new perspectives on the role of digital leadership in fostering exploratory innovation. The finding indicate that digital leadership drives exploratory innovation facilitated by digital entrepreneurial orientation within business management. Ultimately, this study offers insightful and valuable guidance for researchers aiming to better understand the relationship between digital leadership and exploratory innovation.

Theoretical implications

Our research offers several significant contributions to the existing body of knowledge. First, while much of the prior research on digitalization has centered on products, services, models, and processes, the organizational impact of digitalization has often been neglected (Cortellazzo, Bruni, & Zampieri, 2019). Consequently, research on organizational digitalization is still in its early phases, with existing studies dispersed across various topics, including types of digital leadership, shifts in employee work behaviors, technological adoption, performance and talent management, and organizational structures (Schwarz Müller et al., 2018). The breadth and depth of research questions in this field remain limited, highlighting the need for further investigation into how digital technology impacts both leaders and employees (Schiuma et al., 2021; Bharadwaj et al., 2013). This study approaches digitalization from an organizational standpoint, emphasizing the role of individuals. In particular, it investigates how digital leadership shapes digitalization and establishes a theoretical model showcasing its role in fostering exploratory innovation behavior (Wang et al., 2022). Through

this analysis, we contribute to the ongoing discourse on digitalization and digital leadership, directly responding to academic calls such as that from Hesse (2018), to advance research in organizational digitalization.

Secondly, while leadership remains one of the foremost extensively researched areas in organizational science, digitalization is a relatively new phenomenon that has yet to be thoroughly explored. Scholars such as McCarthy et al. (2021), Waal et al. (2016) and Zhu (2015) have examined the competencies and characteristics of digital leadership in depth. However, much of the existing research primarily emphasizes digital leadership's role in strengthening dynamic capabilities, while its broader influence remains underexplored (Mihardjo et al., 2019), particularly in areas such as strategic alliances, market orientation, and innovation management (Wasono & Furinto, 2018). A thorough exploration of the full capabilities of digital leadership has yet to be fully developed (Hesse, 2018). Specifically, in studies examining the connection between exploratory innovation and digital leadership, prior research has acknowledged a positive relationship between the two (L. Mihardjo et al., 2019), but the underlying pathways and procedures have not been sufficiently addressed. By applying RBV and SIP, this study provides a detailed analysis of the mechanisms and processes through which digital leadership impacts exploratory innovation, focusing on strategic orientation with digital entrepreneurial orientation as a mediating factor (Wang et al., 2022).

Third, previous research on leadership styles as antecedents of exploratory innovation has primarily focused on conventional leadership models, including visionary leadership, (Chen et al., 2019), such as collaborative leadership (Gong et al., 2021), shared leadership (Chang et al., 2019), and decentralized leadership (Berraies et al., 2021). Other factors influencing exploratory innovation, digital leadership has recently gained attention as a critical area of study. This research highlights the significance of digital leadership as a distinct and essential leadership style for driving exploratory innovation in the era of digitalization, which is a major challenge for modern enterprises. By emphasizing digital leadership, this study contributes valuable insights into leadership approaches that foster exploratory innovation and deepens the understanding of the mechanisms that drive its development (Wang et al., 2022).

Finally, the increasing prominence digitally oriented strategy research has led us to explore how entrepreneurial orientation operates within the digital landscape and what novel forms it takes. However, existing studies have yet to delve deeply into this issue, with most applying entrepreneurial orientation variables directly from traditional contexts (Ritala, Baiyere, Hughes, & Kraus, 2021). Our research

confirms that digital products and services evolve at a much faster pace in the digital era, exhibiting intermittent and cyclical changes that necessitate an agile and adaptive approach (Lu & Ramamurthy, 2011). These findings introduce market agility as a crucial new dimension alongside the core entrepreneurial traits of innovation, proactivity, and risk-taking, ultimately shaping a new construct: digital entrepreneurial orientation (Wang et al., 2022).

Practical implications

Our research presents several key insights into exploratory innovation comes from digital leadership. First, our results underscore the beneficial influence of digital leadership on exploratory innovation, stressing the importance for leaders to recognize its significance and proactively develop their digital expertise and leadership capabilities. This can be accomplished through intentional learning, involvement in targeted learning initiatives, and active participation in industry discussions. MSMEs are encouraged to recruit digital leaders who exhibit creativity, cognitive and analytical abilities, curiosity, deep expertise, as well as a global perspective and strong collaborative skills. Implementing this approach will help organizations harness the full potential of digital leadership, enabling them to new values can be created and maintain competitiveness in the digital economy.

Second, analysis confirms that digital entrepreneurial orientation plays a mediating role between digital leadership and exploratory innovation. This suggests that for organizations to successfully drive exploratory innovation, strengthening digital leadership is essential. Digital leadership is instrumental in guiding exploratory innovation, from crafting a digital business strategy to ensuring its execution. Supporting team members in expanding their digital expertise through training and education, encouraging engagement and proactivity with performance-based incentives, and creating efficient communication channels are all critical components. Consequently, this enables the rapid development of exploratory innovation.

By applying these insights, organizations can drive their innovation efforts more efficiently in the fast-changing digital era. This highlights the essential role of digital leadership in creating an environment that nurtures innovation, while also emphasizing the strategic incorporation of digital entrepreneurial practices and proactive digital entrepreneurship within the organizational structure. Through this approach, we emphasize the significance of digital leadership in strengthening exploratory innovation. Additionally, this study outlines practical strategies that organizations can utilize to maximize the benefits of digital leadership in securing a competitive advantage in the digital age.

Limitations and future research directions

Our research contributes to an understanding of the role of digital leadership in fostering exploratory innovation, yet there remain several limitations that future studies must address. First, our study's sample is confined to corporations within China, thus raising questions about the relevance of our findings to companies based in other countries or regions. Subsequent research is anticipated to expand to a broader range of countries, regions, and industries to bolster the validity and global applicability of our findings. Second, the influence of other leadership styles, such as transformational and ethical leadership, was not been non MSMEs into our analysis. It is imperative for future research to consider these leadership styles to deepen our understanding of the factors influencing exploratory innovation.

In terms of data processing, our study employed a two-stage approach with temporal separation, involving responses from leaders and employees, to minimize the biases of instantaneous reactions and common methods. The adoption of empirical longitudinal methods or case studies in future investigations could enrich our understanding of causality in the developed model. Furthermore, digital leadership can influence exploratory innovation in the following ways require deeper investigation from various angles. Drawing on the Resource-Based View (RBV) and Social Information Processing (SIP) theories, this study sheds light on the pathways and mechanisms linking digital leadership to exploratory innovation through the lens of strategic orientation. However, alternative mediating factors and pathways such as leader-member dynamics, organizational culture, and structural systems present opportunities for further research.

Future studies should further investigate the precursors and consequences of digital leadership, contributing to the expansion of the existing theoretical framework. As a growing and dynamic research area, digital leadership has primarily been assessed in relation to its qualities and competencies, while its influencing factors, developmental processes, impact outcomes, and underlying mechanisms remain insufficiently explored. Moving forward, research should examine the determinants and formation of digital leadership through organizational factors (such as MSME characteristics and top management team attributes), environmental influences (including competitive dynamics and market trends), and technological aspects (such as digital infrastructure and capabilities). Additionally, the effects and mechanisms of digital leadership can be analyzed at different levels, including employees (e.g., innovative workplace behaviors), leader employee interactions (e.g., trust-building and empowerment), and organizations (e.g., adaptability and agility).

Lastly, this study has introduced and defined the dimensions of the concept of digital entrepreneurial orientation, marking the beginning of research in this area. Future research could expand on this foundation by exploring the impact of digital entrepreneurial orientation and its formation process in various digital contexts, such as digital transformation, digital innovation ecosystems, and digital entrepreneurship ecosystems. For an insightful elaboration on the Social and Resource-Based View Information Processing theories as they pertain to organizational strategies and digital leadership, acclaimed sources such as Barney (2001) on the RBV and Salancik & Pfeffer (1978) on the SIP can be referred to. These foundational texts provide a comprehensive understanding that supports the underpinnings of our theoretical research framework.

Author contributions

In this article, JH and W assumed a central role in the data collection process as well as the drafting process of the manuscript. Concurrently, TS contributed through the construction of the survey instrument and provided cogent revisions and enhancements. Each author made substantial contributions to the article and sanctioned the version submitted for publication.

Conflict of interest

Regarding potential conflicts of interest, the authors assert that this research was carried out in the absence of any commercial or financial relationships that could be inferred as a potential conflict of interest. This assertion underscores our unwavering commitment to academic integrity and transparency throughout this research.

4. CONCLUSION

Strategic Orientation is not just a business direction, but rather an organizational commitment to digitalization that forms innovative capabilities. This orientation functions as a strategic guideline for companies to create the right behavior to achieve sustainable superior performance in the digital era. Digital Leadership is empirically proven to have a positive and significant influence on Digital Innovation. Digital leaders not only adopt technology, but also:

- Build a Digital Mindset and strategic vision to navigate the dynamic digital landscape.
- Act as a bridge between transformation vision and actual implementation, preventing digital projects from simply becoming "IT projects" without cultural change.
- Encourage employee empowerment and collaboration which is crucial to trigger organizational creativity and innovation.

Research concludes that the synergy between digital leadership and strategic orientation creates Digital Foresight, Agility, and Flexibility. Digital innovation often mediates the relationship between leadership and business transformation, meaning

leaders' success depends largely on how effectively they manage the innovation process and this research also shows that Strategic Orientation which focuses on digitalization provides direction for organizations, but its effectiveness really depends on the role of Digital Leadership as the main driver. Digital leadership facilitates the creation of a culture of innovation that not only improves operational efficiency but also builds organizational resilience. Thus, integration between visionary leadership and adaptive strategic orientation is an absolute prerequisite for the success of digital innovation in the era of disruption

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