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Examining the impact of e-leadership on strategic innovation at work: a moderated-mediation model

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Abstract
This research investigates the relationship between e-leadership and strategic innovations in the workplace. It proposes a moderated mediation model that examines inter-team coordination's mediating role and knowledge integration capability's moderating role in this relationship. A sample of 241 working professionals from the United States participated in the study. The findings of this research establish a positive and significant relationship between e-leadership and strategic innovation. e-leadership positively influences the development and implementation of innovative strategies within organizations. Additionally, the study identifies inter-team coordination as a mediator, highlighting the importance of effective team coordination in translating e-leadership into strategic innovation. Furthermore, the research reveals knowledge integration capability as a moderator, indicating that the ability to effectively integrate knowledge across teams and departments enhances the impact of e-leadership on promoting strategic innovation. The study provides valuable insights for practitioners and organizations. Recognizing the significance of e-leadership can help foster an innovative culture and improve strategic decision-making processes. Understanding the mediating and moderating role of Inter-team coordination and knowledge integration capability, emphasizes the importance of knowledge-sharing mechanisms within organizations, highlighting the need for effective knowledge management strategies.

Keywords E-leadership · Knowledge integration capabilities · Inter-team coordination · Innovation

JEL Classification M0 · M1 · M2 · O3

1 Introduction and background

In the contemporary business landscape, organizational leaders find themselves faced with the dual challenge of showcasing technological acumen and concurrently achieving organizational objectives. The pervasive influence of digitalization has fundamentally transformed global business practices, compelling leaders to reassess their approaches. The rapid evolution of technology, coupled with paradigm-shifting events such as the

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pandemic, has necessitated a recalibration of leadership strategies to navigate the complexities of the volatile, uncertain, complex, and ambiguous (VUCA) world (Chamakiotis et al., 2021). Traditional leadership paradigms have proven inadequate in addressing the challenges posed by this dynamic environment, thereby prompting the emergence of a reimagined form of leadership. In response to external adversities and the imperative for adaptability, organizations have sought to cultivate e-leadership—a cadre of adept professionals possessing a nuanced understanding of business imperatives and technological intricacies (Larson & DeChurch, 2020). While leaders incorporating technology into their roles is not a novel concept in the era of high-speed internet and social media, the distinction lies in the acute familiarity of e-leaders with technology and its alignment with organizational goals. E-leaders approach technology not merely as automated tools but as dynamic elements that influence team requirements at various stages of work (Larson & DeChurch, 2020). Although the exigencies born out of the pandemic may have accelerated the need for e-leadership, viewing it solely as a survival strategy in response to immediate challenges could be myopic. The overarching objective of e-leadership is to cultivate an adaptive environment that accommodates the continual evolution of technology, ensuring sustained benefits from technological advancements (Liu et al., 2020).

The conceptualization of e-leadership dates back two decades; however, the COVID-19 pandemic forced academicians and practitioners to reimagine the role of e-leadership in the context of the digitalized workplace (Chamakiotis et al., 2021). Avolio et al. define e-leadership as "a social influence process mediated by advanced information technology to produce a change in attitudes, feelings, thinking, behavior, and/or performance with individuals, groups, and/or organizations" (2000, p. 617). However, with technology taking a front seat in the advancements, the definition of e-leadership has changed with time. Van Wart et al. define e-leadership as "the effective use and blending electronic and traditional methods of communication. It implies an awareness of current information and communication technologies (ICTs), selective adoption of new ICTs for oneself and the organization, and technical competence in using those ICTs selected" (2019, p. 87). The current understanding of e-leadership revolves around how it impacts virtual teams and organizational activities. E-leadership plays an instrumental role in ensuring the effective and goal-oriented functioning of a virtually located workforce (Carroll & Conboy, 2020). E-leadership is not limited to managing virtual teams; it impacts the overall organizational functioning by engaging in clear communication, constant interactions with the employees, inculcating trust among the virtual workforce and demonstrating technical know-how that inspires followers (Roman et al., 2019). Chamakiotis et al. (2021) have proposed that e-leadership may influence diverse innovation outcomes by channelling creativity, engagement, and trust among employees. Focusing on technology's impact on strategic outcomes, this study proposes and tests the mediating role of inter-team coordination between e-leadership and strategic innovation. The authors also examine the moderating role of knowledge integration capability between e-leadership and strategic innovation.

One of the most pressing issues in front of e-leadership is to bring the distributed workforce together and encourage them to contribute to organizational strategy through continuous innovation (Liu et al., 2020). E-leadership has the potential to impact innovation that is aligned with organizational strategy, i.e., strategic innovation, although the technological and social barriers must be overcome. E-leaders have a deeper understanding of digitalization, enabling them to carefully evaluate the organization's needs and employees' capabilities and choose appropriate technological resources (Van Wart et al., 2019). This digital expertise helps e-leaders mitigate any probable resistance from the employees. Social barriers are mainly communication barriers that prevent the smooth flow and exchange of

knowledge and resources. Due to fast-paced digitalization, there is a possibility of ambiguity, apprehension, misinformation, or conflict among the team members which can impair inter-team coordination (Raineri & Valenzuela-Ibarra, 2022). E-leaders are expected to play the role of a bridge among distributed team members and ensure that communication barriers are eliminated. This study aims to unveil the ability of e-leadership to impact strategic innovation via enhanced inter-team coordination in the presence of knowledge integration capability.

This study can be considered significant for the following reasons. First, we add to the limited understanding of e-leadership and its impact on organizational outcome, i.e., strategic innovation (Chamakiotis et al., 2021; Contreras et al., 2020). With the rapid digitalization of businesses across economies, studying how e-leadership can be leveraged to gain competitive advantages is imperative. This study investigates the impact of e-leadership on strategic innovation. Second, this study responds to the call for research by Chamakiotis et al. (2021), which suggests examining the potential of e-leadership to drive different types of innovation outcomes. This study examines the influence of e-leadership on how various teams collaborate and deliver innovation aligned with organizational strategy. The study uncovers how team members' communication within themselves and with other teams impacts the e-leadership—strategic innovation relationship. Third, this study presents significant implications for organizations that have transformed into or are going to transform into a digitalized workplace. Such organizations are required to identify managers with technology expertise and generate e-leaders that can combine business and digital capabilities. This study presents a mechanism through which digitalized organizations can leverage the capabilities of e-leadership and encourage employees to thrive for strategic innovation.

The remainder of the paper is structured as follows: Sect. 2 presents the literature background involving the constructs of the study and the development of the hypotheses. The methodology followed by the authors to test the hypothesized model has been presented in Sect. 3. The next section presents the findings of the analysis. The subsequent sections present a discussion of the results, implications of the study, and conclusion.

2 Theoretical underpinnings

2.1 Complexity leadership theory

Complexity leadership theory (CLT) (Uhl-Bien et al., 2007) comprehensively explores strategies and behaviours to foster creativity, learning, and adaptability within organizational and subunit contexts. This exploration focuses on instances where complex adaptive systems (CAS) dynamics come into play within hierarchical coordination frameworks, such as bureaucratic structures (Uhl-Bien & Marion, 2011). CLT delineates three primary forms of leadership operating within this framework. Firstly, administrative leadership adheres to traditional bureaucratic principles, emphasizing hierarchy, alignment, and control. Secondly, enabling leadership is characterized by its role in structuring and facilitating conditions that optimize CAS dynamics, enabling effective problem-solving, adaptability, and learning. Lastly, adaptive leadership is viewed as a dynamic force that drives emergent change activities.

The complexity leadership perspective is underpinned by several key concepts (Uhl-Bien & Marion, 2011). One crucial concept is recognising that the informal dynamics

discussed are deeply embedded within their respective contexts. In the context of complex adaptive systems, the significance of the environment goes beyond being a mere antecedent, mediator, or moderator variable; instead, it serves as the backdrop that shapes a system's dynamic identity. In complex systems, this identity is defined by the nature of interactions and interdependencies among various agents, hierarchical divisions, organizations, and their environments. Both CAS and leadership are products of this social construction within the contextual backdrop, evolving over time in response to the patterns and dynamics inherent within the environment (Uhl-Bien et al., 2007).

CLT provides a comprehensive understanding of our hypotheses as it can illustrate the complex relationship between leadership and strategic innovation at work. With its focus on understanding leadership dynamics within complex adaptive systems, CLT offers valuable insights into how E-leadership functions within organizational structures characterized by intricate interdependencies and adaptability.

2.2 E-Leadership and technology transfer

E-leadership is instrumental for effective and efficient technology transfer, as it realizes the potential of digital platforms for information and knowledge sharing while mitigating the potential distractions of information overload (Butticè & Vismara, 2022). By providing clear direction and promoting direct participation, e-leaders ensure that organizational actors collaborate efficiently, thereby enhancing the overall impact of technology transfer initiatives (Rådberg & Löfsten, 2024). Furthermore, strong leadership channels the efforts of multiple actors, building the firm's technology transfer competence and ensuring that new technologies are integrated seamlessly into the organizational activities (Bolatan et al., 2022). Consequently, e-leadership is essential in orchestrating successful technology transfer, balancing the flow of information, and fostering collaboration and partnerships.

3 Hypothesis

3.1 E-leadership and strategic innovation

Digitalization has emerged as the necessary means for leaders to respond to dynamic and volatile business environments (Adomako et al., 2021). Various communications technologies and platforms have allowed organizations and leaders to utilize differently located talent via virtual teams. However, these technologies often bring the added baggage of unforeseen challenges and complexities over the benefits they provide (Arslan et al., 2021). Traditional leadership approaches may not be effective in managing such a situation since the dynamics of the digitalized workplace are completely distinguished from the usual workplace once known to leaders (De Vries et al., 2019). These digitalized workplaces can be considered a complex adaptive system with each employee as a knowledge-producing unit. According to complexity leadership theory, leaders must play a diverse set of roles that can foster an environment of creativity, learning and adaptive performance (Uhl-Bien et al., 2007). E-leaders can balance learning, empowerment and performance, ensuring administrative responsibilities are taken care of while encouraging employees to aim for creative and innovative performance. E-leaders empower their followers by engaging in clear and inspiring communication regarding the organisation's strategic direction, thus ensuring a goal-oriented effort from the followers. By exhibiting complexity leadership,

e-leaders are better equipped to manage the usual challenge of selecting appropriate tools and technologies that give maximum business returns (Van Wart et al., 2019). In addition to the business outcomes, e-leaders are well aware of the impact of digital tools and technologies on people; hence, they can leverage digitalization to encourage employee trust (Avolio et al., 2014; Van Wart et al., 2019). They can enhance the innovative performance of virtual teams by fostering an environment of digital well-being, which allows the workforce to contribute to organizational strategic goals (Chamakiotis et al., 2021). Hence, we argue that e-leaders, while still accounting for control and structure, enable people to adapt to digital transformation and continue to learn and deliver strategic innovation. Hence, we hypothesize:

H1 E-leadership is positively related to strategic innovation.

3.2 E-leadership and inter-team coordination

Digitalization introduces a certain ease in the interaction process among team members; however, it brings a set of challenges and difficulties in coordination (Contreras et al., 2020). In a digitally capable organization, teams are often not present in the same geographic location. They might be located in different continents connected through a digital infrastructure. In such situations, interaction among different teams can become difficult due to multiple limitations. Moreover, if the digital infrastructure for knowledge sharing is not user-friendly, it can have an adverse effect on employees' mental health and job performance (Nguyen et al., 2023). Experiencing anxiety caused by constant changes in the workplace may negatively impact knowledge sharing among employees (Luqman et al., 2023). On the other hand, empowering leadership can positively influence knowledge sharing and knowledge creation among teams working in a digitalized context (Goswami & Agrawal, 2023). Within the premises of complexity leadership theory, e-leaders encourage employees and teams to engage in a fair exchange of ideas, information, knowledge and skills in order to enhance the learning and coordination among different parts of the organization. From the team performance point of view, trust in e-leadership and coordination among team members are both necessary elements (Elyousfi et al., 2021). Since digitalization naturally creates a certain physical distance and complexities among the team members, the role of e-leaders becomes more pertinent (Contreras et al., 2020). Through clear, consistent and authentic communication, e-leadership exhibits managerial skills that bind the team members together, who might be located in different continents, and help them work more cohesively (Höddinghaus et al., 2023). We argue that effective e-leadership establishes and maintains a continuous exchange of information and resources to achieve goals. Hence, we hypothesize:

H2 E-leadership is positively related to inter-team coordination.

3.3 Inter-team coordination and strategic innovation

Inter-team coordination becomes paramount when the organization's resources and skills are unevenly distributed. Organizations can develop strategic agility when the abilities and resources are utilized in a coordinated manner (Tarba et al., 2023; Zahoor et al., 2022). In addition to formal knowledge sharing, tacit knowledge sharing in terms of advice, feedback, and suggestions is crucial to drive organizational success (Magni et al., 2023). The

challenge in creating this synergy remains a puzzle, i.e., the resources and knowledge are often held by different teams that do not have the appropriate extent or opportunity for collaboration. In such a situation, the teams must adapt to the changing environment and learn how to consistently exchange resources and knowledge necessary for innovation (Del Giudice et al., 2021). Researchers have repeatedly stressed the importance of within and inter-organizational collaboration to overcome external barriers (Iftikhar et al., 2022; Zahoor & Al-Tabbaa, 2020). Organizations with fluidity of knowledge and skills among teams are likely to build an environment of innovation linked with strategic goals (Gemünden et al., 2018). Different teams in an organization may have separate goals, visions, cultures and ways of working. However, when teams successfully establish a channel through which knowledge, skill, and resources are shared, their efforts contribute to a common goal through innovation. Hence, we hypothesize the following:

H3 Inter-team coordination is positively related to strategic innovation.

3.4 The mediating role of inter-team coordination between e-leadership and strategic innovation

Complexity leadership theory (Uhl-Bien et al., 2007) recognizes the multifaceted role of leaders in dynamic and complex environments. They adaptively manage order, stabilize and maintain efficiency under administrative leadership, and pivot towards the creation of new business avenues and innovation in response to changing market requirements under entrepreneurial leadership. They foster a supporting environment for their workforce through the development of communication, collaboration and a learning culture under enabling leadership. Recent literature has identified linkages between leadership and desired innovative organizational outcomes. Zhang and Zhao (2024) underscore the mediating impact of organizational harmony between inclusive leadership and employee innovation behaviour. Akhtar et al. (2023) substantiate the mediating role of ethical culture between responsible leadership and green innovation. Alzghoul et al. (2024) showcase the mediating effect of a knowledge-centred culture on knowledge-oriented leadership and service innovative behaviour. Nguyen (2023) showcases technology-mediated knowledge sharing, having a mediated relation between transformative leadership and organizational innovation. Donate et al. (2023) further highlight the mediating impact of task management conflict between knowledge-oriented leadership and innovation capability. Thus, based on prior literature, researchers conclude that leaders are crucial in bridging the workforce and providing a roadmap towards desired innovation behaviour. The present study has also hypothesized the positive impact of e-leadership and inter-team coordination on strategic innovation. Thus, researchers hypothesize:

H4 Inter-team coordination mediates the relationship between e-leadership and strategic innovation.

3.5 Moderating the role of knowledge integration capability between e-leadership and inter-team coordination

Knowledge is often trapped in the tacit boundaries among the experienced members of the organization. However, when such employees exhibit knowledge-sharing intentions,

it creates an environment of voluntary engagement (Fait et al., 2023). Employees' active knowledge-intensive participation helps build a firm-level competitive advantage (Hussain et al., 2022). When employees collaborate with their knowledge assets for a common goal, it positively contributes to knowledge integration and new knowledge creation (Acharya et al., 2022). Salunke et al. (2019) define knowledge integration capability (KIC) as the ability to successfully combine new and old knowledge, keeping the business requirements in focus. In the digitalization era, KIC involves the process of a) integrating new and old knowledge to respond to digital challenges and b) gathering knowledge held by a select few team members and making it available to all those who need it. The combination of new and existing knowledge resources can be utilized to achieve organizational goals. Higher knowledge integration capability impacts the information technology capability of the firm and leads to novelty-oriented business practices (Guo et al., 2021). Studies have also found that knowledge integration capability moderates the impact of digital capabilities on desirable performance outcomes (Gong et al., 2022; Xie et al., 2022). Knowledge integration among peers and across hierarchical boundaries helps organizations run business smoothly despite facing severe external challenges (Guo et al., 2023). Following the same, it can be argued that teams with higher KIC will be able to enhance the positive influence of e-leadership on inter-team coordination (Fig. 1 illustrates the hypothesized model). Hence, we hypothesize:

H5 Knowledge integration capability moderates the impact of e-leadership on inter-team coordination such that the effect will be stronger when knowledge integration capability is higher.

4 Methodology

Data for the study was collected through a survey questionnaire filled out by 241 respondents (across different firms) (finalized sample after removing incomplete and redundant survey forms). Initially, the survey form was floated among 350 respondents employed in the USA's information technology and software industry. The authors used their personal contacts and social media platforms to reach out to the potential respondents for the main

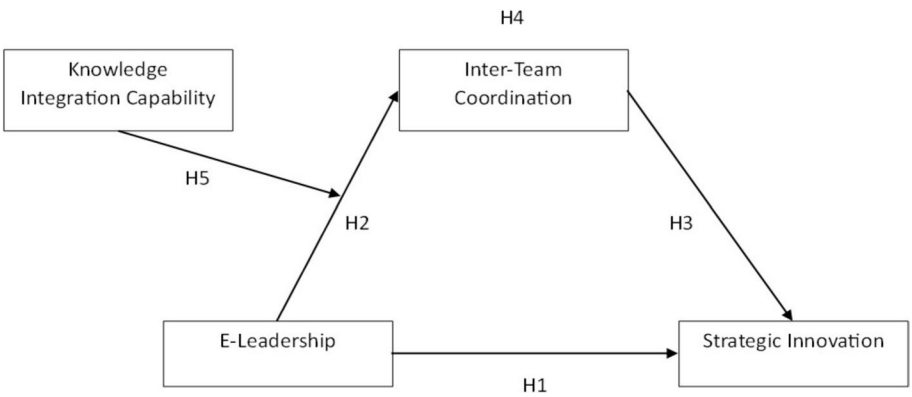

Fig. 1 Hypothesised model

study. Only participants aged 18 or above and employed full-time in a firm were chosen for the study. The questionnaire for the study was designed using established scales. All responses to the questions were collected through a 7-point Likert scale. A priori test was conducted to determine the sample adequacy, which was way above the required threshold. The choice to limit our sample to the information technology industry is multi-folded. First, the IT industry is believed to have heavily moved from the traditional office model to remote work post-COVID era. This is also evident from recent surveys, such as the Bureau of Labor Statistics' recent report that found one in five US workers are engaged in telework post-2020. Another study suggests that nearly two years into the COVID-19 pandemic, roughly six in ten U.S. white collars who say their jobs can mainly be done from home (59%) are working from home all or most of the time (Parker et al., 2022). Therefore, it is not surprising that it has also given rise to e-leadership taking a critical role in organizations. Second, the decision to explore the IT industry was also motivated by accessibility issues. One of the authors is engaged in teaching and consulting at a leading US-based university specialising in information systems management, and every year, the university attracts a significant number of experienced IT professionals who opt for executive education and training at the university. The alums of these programmes are currently engaged in different managerial roles across different IT firms in the USA. It was possible to approach them through social media platforms and mutual contacts in the authors' networks.

4.1 Measure

We measured E-leadership using a 4-item scale developed by Ben Sedrine Doghri et al. (2021). Similarly, Inter-team coordination was measured using a two 2-item scale previously used by Hoegl et al. (2004). The researchers measured knowledge integration capability (KIC) using a 10-item scale developed by Gardner et al. (2012) and recently used by Yu et al. (2022). Strategic Innovation was measured using a 5-item scale developed by Miller and Friesen (1983).

The authors used age, technological experience, gender, and educational qualification as control variables. This is consistent with previous studies (e.g., Rizzuto, 2011). We also checked for the reliability of scales through a pre-test/face validity study with 18 respondents consistent with prior research (e.g., Reis et al., 2017). In the first data collection stage, we collected data on demographic details and the independent variables. After a lag of one week, mediating and moderating variables were measured, followed by another gap of one week, after which we collected the responses on dependent variables questionnaires (Kukreja & Pandey, 2023). To ensure consistency, we assigned unique identification numbers to each respondent; their email id and contact information were collected to send them gentle reminders for timely submission of the forms in all three stages. Temporal lag has been considered as one of the desired approaches to reduce common method biases in the relevant literature (Kock et al., 2021).

Choosing the US context: The USA has been at the forefront of e-leadership and e-government initiatives, making it an ideal context for studying the influence of e-leadership on virtual team performance. The USA has made significant investments and progress in enhancing public services and improving government operations through e-governance (Dawes, 2008). Notably, during the COVID-19 pandemic, the work culture met with a sudden change that included but was not limited to remote working. A recently published Forbes article highlighted how these changes gave rise to E-leadership in the USA (Nabil

Table 1 Descriptive statistics, reliability estimates and study variable intercorrelation

	Mean	SD	1	2	3	4	5	6	7
1. EL	4.9263	1.38820	(0.907)						
2. ITC	4.900	1.0898	.573**	(0.778)					
3. KIC	5.1447	1.0648	.594**	.725**	(0.917)				
4. SIN	4.4397	1.2232	.316**	.399**	.306**	(0.814)			
5. WE	17.666	9.8811	.045	.059	.091	.030	1		
6. EQ	2.37	.975	.124	.028	-.033	.04	.106	1	
7. Age	38.47	10.290	.098	.073	.117	.063	.882**	.172**	1

N = 241, Reliabilities are in the parentheses on this diagonal, ** $p < 0.01$

Table 2 Validity analysis

Construct	CR	AVE	MSV	SIN	KIC	LE	ITC
SIN	0.825	0.555	0.229	0.745			
KIC	0.906	0.549	0.530	0.367	0.741		
LE	0.909	0.716	0.425	0.367			
ITC	0.783	0.645	0.530	0.479	0.728	0.652	

N = 241, CR: critical ratios, AVE: Average variance extracted, MSV: maximum shared variance

Bouassaba, 2022). An estimate suggests that by 2025, over 32.6 million Americans will work remotely.

Furthermore, over 20% of US-based companies are expected to operate entirely remotely in the next few years (Katherine Haan, 2023). Looking at the growing demand for remote work and virtual teams in the USA, there is a strong likelihood that the demand for e-leadership will grow further soon. Interestingly, research on e-leadership that focuses on the context of the United States remains missing.

5 Findings

We performed confirmatory factor analyses (CFA) using AMOS version 28 (Hair et al., 2011), and hypotheses were tested using the latest available version of Hayes's Process Macro (Hayes, 2017). The results of convergent validity and internal reliability have been provided in the tables. As illustrated earlier, we controlled for the common method bias through a temporal separation of one week across the different stages of data collection (Kock et al., 2021). This is consistent with recent research that suggests temporal separations exceeding three days (Kukreja & Pandey, 2023). We also conducted Harman's single-factor test to check for any common method variance and observed that a single constrained factor explained less than 50% of the total variance.

The descriptive statistics, including mean, standard deviation, intercoder, and reliability measures, are reported in Table 1. Cronbach's alpha and composite reliability (CR) values were consistent with previous studies (Nunnally & Bernstein, 1994) (Table 2). The average variance extracted (AVE) helped us measure the convergent validity, which was higher than 0.5. For the discriminant validity, we followed maximum shared variance (MSV) < average

Table 3 Model fit measures

Measure	Estimate	Threshold	Interpretation
CMIN	220.629	–	–
DF	146	–	–
CMIN/DF	1.511	Between 1 and 3	Excellent
CFI	.973	> 0.95	Excellent
SRMR	.0373	< 0.08	Excellent
RMSEA	.046	< 0.06	Excellent
PClose	.687	> 0.05	Excellent

N = 241, CMIN: chi-square, DF: degree of freedom, CMIN/DF: discrepancy divided by degree of freedom, CFI: comparative fit Index, SRMR: standardized root mean squared residual, RMSEA: root mean square error approximation, PClose: *P*-value of null hypothesis

Table 4. Regression results of mediation

Inter-team coordination	Beta	SE	t	*p*
(a) Mediator variable model				
Constant	4.8774	.37	12.97	0.0000
E-Leadership (EL)	.2866	0.06	4.56	0.0000
Knowledge integration capability (KIC)	.6844	0.08	7.82	0.0000
E Leadership X knowledge integration capability	.1006	0.03	2.84	0.0048
Age	-.0079	0.01	-0.54	0.5880
Gender	.0592	0.13	0.42	0.6703
Work experience	.0043	0.01	0.28	0.7731
R-squared	0.4406			
F	26.2211***			
(b) Dependent variable model				
Strategic innovation	beta	Se	t	*p*
Constant	2.87	.50	5.68	0.0000
E-leadership (EL)	0.13	.06	2.16	0.0313
Inter team coordination (ITC)	0.24	.06	3.97	0.0001
Age	0.01	.01	0.70	0.4827
Gender	0.04	.14	0.28	0.7740
Work experience	-0.00	.01	-0.53	0.5922
R-squared	0.1588			
F	7.3598***			

N = 241, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

variance extracted; the square root of AVE is greater than inter-construct correlations. We have reported the goodness of fit indicators results in Table 3.

All our hypotheses were supported (Refer to Tables 4a,b, 5 and 6, 7). E-leadership (EL) was positively related to strategic innovation (SIN) (β 0.13, $p < 0.01$) (See Table 4a, b). Similarly, E-leadership was also positively related to Inter-team coordination (ITC) (β 0.2866, $p < 0.001$). Furthermore, the Inter-team coordination was positively related

Table 5 Conditional effect of knowledge integration capability as a moderator on the relationship between e-leadership on strategic innovation

Conditional effect of moderating variable	Effect	SE	t	*p*	BootLLCI	BootULCI
KIC (-1)	0.1717	0.0717	2.5011	0.0131	0.0381	0.3208
KIC (0.00)	0.2866	0.0628	4.5628	0.00	0.1628	0.4103
KIC + 1 (1.0)	0.3938	0.0747	5.2725	0.00	0.2466	0.5409

N = 241, BootLLCI: bootstrapping lower limit confidence interval, BootULCI: bootstrapping upper-level confidence interval

Table 6 Direct effect of e-leadership (EL) on Strategic innovation (SIN)

Effect	SE	t	*p*	BootLLCI	BootULCI
0.1380	0.0637	2.1665	0.0313	0.0125	0.2634

N = 241, BootLLCI: Bootstrapping lower limit confidence interval, BootULCI: bootstrapping upper-level confidence interval

Table 7 Indirect effect of e-leadership on strategic innovation via inter-team coordination (ITC)

Indirect effect of e-leadership on strategic innovation via inter-team coordination	Effect	BootSE	BootLLCI	BootULCI
ITC (-1)	0.0444	0.0243	0.0039	0.0982
ITC *(0.00)*	0.0709	0.0279	0.0244	0.1321
ITC (+ 1.00)	0.0974	0.0344	0.0372	0.1707

N = 241, BootLLCI: Bootstrapping lower limit confidence interval, BootULCI: bootstrapping upper-level confidence interval

to strategic innovation. We could identify the moderating (Refer to Table 5) and mediating effect (Refer to Table 6a, 7) of knowledge integration capability (KIC) and ITC, respectively.

6 Discussion

The contemporary business landscape is marked by rapid technological advancements, challenging traditional leadership paradigms and necessitating a shift toward digital leadership. Through their extensive and state-of-the-art review, Inceoglu et al. (2024) highlight five key themes of digitalization and resource mobilization with diverse and global examples that shed light on previously underexplored topics, extensively contributing to the overall domain development. Adding to the discourse, the present study contributes to the digitalization context by examining research management issues beyond digitalization. In response to the evolving demands of the VUCA world, the study recognizes the imperative of cultivating e-leadership—a cadre of leaders proficient in technology and business acumen. It addresses this pressing need by delving into the intricate dynamics of e-leadership, leveraging the complexity leadership theory as a conceptual framework. In the realm

of academic inquiry, a multitude of prior studies (Amankwaa et al., 2022; Aragón-Correa et al., 2007; Noruzy et al., 2013) have delved into various dimensions of leadership and their impacts on innovation across different domains. Recent scholarly investigations have further expanded this discourse, examining the influence of digital leadership on open innovation (Fatima & Masood, 2024), paradoxical leadership on team-level innovation (Pearce & van Knippenberg, 2024), transformational leadership on the green process and product innovation (Pham & Pham, 2023), and innovation capability (Le & Le, 2023). However, the current study represents a pioneering endeavour by leveraging the complexity leadership theory (Uhl-Bien et al., 2007) to explore the ramifications of e-leadership on strategic innovation and inter-team coordination, with the latter acting as a mediator in the relationship, while knowledge integration capability moderates this mediating relationship. Thus, the conceptual framework of this study responds to a notable research imperative outlined by Chamakiotis et al. (2021), advocating for an examination of the potential of e-leadership to drive diverse innovation outcomes.

The initial findings (H1) underscore a positive and direct association between e-leadership and strategic innovation. These findings affirm that e-leaders, equipped with digital proficiency and adept at integrating digital and traditional communication, possess a visionary approach and demonstrate adaptability to varying market demands, thereby fostering a culture of innovation and change within their workforce. These findings align with previous literature emphasizing the pivotal role of e-leadership in stimulating innovative employee work behaviour, often mediated through psychological capital and employees' emotional commitment (Li & Xiao, 2023).

Subsequent findings (H2) illuminate a direct and positive correlation between e-leadership and inter-team coordination. The e-leaders, leveraging various communication technologies such as company-wide Slack channels, video conferencing tools, or intranet-based digital workspaces like Switchboard and Notion, adeptly facilitate seamless knowledge sharing crucial for geographically dispersed teams. This synchronized coordination enhances operational efficiency and contributes to team effectiveness (Xie et al., 2022). Subsequent findings (H3) underscore a robust positive correlation between inter-team coordination and strategic innovation. This research unveils the indispensable role of collaborative approaches encompassing implicit, tacit, or explicit knowledge sharing, knowledge transfer (Wang et al., 2024), exchange of ideas, perspectives, and insights, as well as resource-sharing, all of which collectively nurture an innovation-centric culture and drive strategic innovation. Building upon these findings, Barbosa et al. (2021) elucidate the favourable impact of both organic and mechanistic coordination processes on open innovation project performance within R&D teams.

Hypothesis (H4) sheds light on the mediating role of inter-team coordination between e-leadership and strategic innovation. It elucidates that when leaders foster knowledge dissemination through diverse digital and traditional communication channels, they cultivate an environment conducive to collaboration and knowledge exchange among team members, thereby promoting an ethos of engagement and learning that ultimately fuels innovation. These findings resonate with the work of Naqshbandi and Tabche (2018), who also demonstrate the mediating influence of organizational learning culture between leadership and open innovation. Additionally, Duan et al. (2023) underscores the mediating role of the creative engagement process between temporal leadership and team creativity, further reinforcing the interconnectedness of leadership, collaboration, and innovation in organizational settings. The subsequent findings (H5) shed further light on the moderation impact of knowledge integration capability on e-leadership and inter-team coordination. The results showcase, knowledge integration capability, which involves the process

of synthesizing knowledge, skill and even insights from different sources, have a crucial moderating impact. The abundance of knowledge in firms, rather than being in silos, needs to be fostered through a culture of knowledge sharing. This would facilitate organizational learning by optimizing the quality and quantity of knowledge (Guo et al., 2021), leading to capitalization of synergies from e-leadership and inter-team coordination.

Prior studies have explored facets of leadership and their impacts on innovation, examining digital leadership's role in open innovation, paradoxical leadership's influence on team-level innovation, and transformational leadership's effects on green process and product innovation. However, this study stands out as the first to systematically investigate the impact of e-leadership on strategic innovation and inter-team coordination, with a nuanced examination of the mediating role of inter-team coordination and the moderating influence of knowledge integration capability. In doing so, the study extends the theoretical underpinnings of leadership and innovation and provides practical insights for organizations grappling with the challenges of a digitalized and volatile business environment. In the broader context of the current business landscape, characterized by rapid technological advancements, global interconnectedness, and uncertainties, the study's findings carry significant implications. Organizations that invest in developing e-leadership capabilities stand to gain a competitive edge in navigating the complexities of the contemporary business environment. The study advances theoretical knowledge aas well as provides practical insights for organizational leaders seeking effective strategies for fostering innovation in their teams. As businesses grapple with the challenges and opportunities presented by the digital era, the study underscores the critical role of e-leadership in driving strategic innovation. It highlights the importance of fostering collaborative and knowledge-sharing practices within teams. Ultimately, the research contributes to the ongoing dialogue on leadership and innovation, offering valuable insights for scholars, practitioners, and organizational leaders.

7 Theoretical implications

The study's findings offer rich, multi-fold insights from a theoretical lens. First, the study extends the complexity leadership theoretical underpinnings by testing the influence of e-leadership on inter-team coordination and strategic innovation in the presence of knowledge integration capability. This provides a way for the literature to test time-honoured leadership theories in dynamic and technologically-enhanced contexts. Second, the e-leadership research domain has received less scholarly attention, considering its potential impact (Alkhayyal & Bajaba, 2023; Avolio et al., 2014). The past research focuses on innovation capacity (Liu et al., 2020), ambidextrous innovation (Ben Sedrine Doghri et al., 2021), and employee innovation behaviour (Li & Xiao, 2023); however, the present study integrates the e-leadership domain with strategic innovation. By examining the effect of e-leadership on strategic innovation, the authors respond to the call for research by Chamakiotis et al. (2021), which suggests identifying the conditions under which e-leadership influences specific innovation outcomes. The present research also addresses the research gap highlighted by Hughes et al. (2018) concerning further research focusing on the relationship between leadership and innovation. Our study empirically addresses the gap by conducting research in the context of the IT workforce from the USA. The study also challenges the remarks given by Kulshreshtha and Sharma (2021) which suggest that the effectiveness of e-leadership is limited to communication only. The present study concludes that e-leadership has the potential to impact the strategic endeavours of the organization. Third,

the study processes inter-team coordination as a mediator between e-leadership and strategic innovation, which uncovers that coordination mechanisms and communication patterns in teams are vital, influencing innovation outcomes. Fifth, the moderating effect of knowledge integration capability illuminates the circumstances under which e-leadership practices are most effective at nurturing collaboration and coordination.

8 Practical implications

In terms of practical implications, the study also offers some profound insights. First, with changing business dynamics and technological advancement, firms should transition their managers and upper management to e-leadership roles. They should be equipped with the essential skill sets and training (Alkhayyal & Bajaba, 2023; Chamakiotis et al., 2021). This would allow the firms to utilize their managers' full potential and competency, promoting innovation. Second, collaboration, coordination, and cooperation lie at the epicentre of inter-organizational activities. Thus, firms should practice regular inter-team level meetings, including review and retrospective meetings, that would solve the unidentified dependency problem (Dingsøyr et al., 2023). Further investing in inter-team coordination and team-building activities would reduce redundant work, solve synchronization issues, reduce work handovers, and establish transparent and robust team relations facilitating shared purpose. It may further help overcome linguistic and geographical barriers employees face in virtual teams. They may encourage cross-functional collaboration, leading to knowledge transfer and integration of diverse expertise views, leading to innovative solutions. For example, leaders can also use conversational AI technology to prepare and share meeting minutes with all the team members for further coordination.

Third, the managers should establish an effective feedback channel learning repository to promote inter-team coordination and strategic innovation. The regular feedback mechanism would aid in reflecting the coordination process, identifying improvement opportunities, and benchmarking best practices. A learning repository would facilitate the continuous upkeep of knowledge for employees, resulting in enhanced innovation outcomes. Finally, businesses should revise their performance evaluation and recognition strategies to encourage and reward inter-team coordination and innovative thinking among their employees. This would enable the workforce to focus more on these factors, resulting in increased innovation outputs.

9 Limitations and future research

Despite extensively examining the direct, mediating, and moderating relationships among e-leadership, strategic innovation, inter-team coordination, and knowledge integration capability, the present study possesses some limitations that provide scope for future research avenues. First, as the study is conducted with cross-sectional data, researchers can't establish a causal relationship among variables, as the relationships among variables may change over time. Thus, future researchers can employ longitudinal research methodologies or case studies to provide more credibility to the study's conclusion. Second, the sample for the study was limited to employees at the managerial level, which may have led to bias (Kaya et al., 2020). Thus, future studies are encouraged to adopt mixed-method research approaches, including interviews, focus group discussions, or discourse analysis

with multiple stakeholders. Even multi-study research, combining experiments followed by a cross-sectional field study, may provide deep insights. Third, the present study was conducted in the context of IT employees in a developed economy such as the USA. Future studies can replicate the study in transitional or underdeveloped economies in different sectors. Also, multi-countries or comparisons between developed and underdeveloped countries may lead to interesting findings. Fourth, the study explores the direct relationship between inter-team coordination and e-leadership in strategic innovation. Future studies may explore additional antecedents of strategic innovation from the lens of indigenous variables from ancient text, upcoming digital technologies, communication, ethics, or gender, which may lead to novel findings and advancement of the domain.

10 Conclusion

Digitalization is an inevitable strategic endeavour that organizations need to venture into to stay relevant and competitive in the market. One of the evident responses to this paradigm-shifting change is to create more e-leaders and leverage their expertise in their respective areas. This study helps us conclude that e-leadership can enhance coordination among individuals and groups, which motivates the workforce to deliver innovative performance aligned with the firm's strategy. E-leaders possess a balanced skill set varying from understanding business needs to maximizing tech-enabled output. Such a combination of skills allows e-leaders to be not only better administrators but also better at empowerment. This study also stresses the importance of the firm's knowledge integration capability. Firms are required to encourage their knowledge workers to seek new insights consistently and merge them with organizational knowledge resources. Such a capability increases the possibilities of collaboration that contributes to strategic innovation.

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