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Harnessing digital foundations and artificial intelligence synergies: Unraveling the role of digital platforms, artificial intelligence, and strategic adaptability in organizational innovativeness

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ABSTRACT

This research investigated the relationships between digital platforms, artificial intelligence (AI) adoption, and organizational innovativeness, presenting e-knowledge and big data analytics capability as mediators and strategic flexibility as a moderator. The study posited that digital platforms significantly foster the development of e-knowledge and that AI adoption is closely associated with enhancing big data analytics capability. Additionally, it examined the direct effects of e-knowledge on organizational innovativeness and the pivotal role of big data analytics capability in shaping organizational innovativeness; the mediating effects of e-knowledge on the relationship between digital platforms and organizational innovativeness as well as the mediating role of big data analytics in the association between AI adoption and organizational innovativeness; and strategic flexibility role in strengthening the connection between digital platforms and organizational innovativeness and its influence on the relationship between AI adoption and big data analytics capability. To collect data, a questionnaire comprising 550 items was distributed to respondents from educational institutions. A structural equation modeling approach was employed to analyze the collected data. By addressing these constructs, the study provided a comprehensive model for understanding how digital platforms and AI adoption can drive organizational innovativeness through strategic data management and information analytics capabilities. The findings offer significant insights and actionable recommendations for experts and practitioners seeking to enhance organizational creativity within the digital landscape.

Introduction

Organizational innovativeness has become increasingly critical to the smooth running of the organization because it offers a competitive advantage, particularly in the context of advanced technologies and industrial integration (Haefner et al., 2021). In the era of digitalization, emerging technologies combined with dynamic environments compel businesses to innovate their models to remain competitive (Fajimolu et al., 2023). Digital transformation is pivotal for fostering innovation; organizations must continually acquire new knowledge and adopt advanced technologies to refine their operational processes and business models (Sun et al., 2024). The emergence of digitalization necessitates various adjustments to organizational resources that enable the creation of innovative business models (Mies & Hausberg, 2023). Therefore, the current study explores the factors that are critical for promoting organizational innovativeness.

Over the past decade, the technological landscape has undergone rapid transformation, with enterprises increasingly leveraging digital

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platforms and artificial intelligence (AI) to enhance their operations, executive practices, and overall innovativeness (Łobejko, 2020). Organizational innovativeness involves the introduction of new ideas, products, technologies, processes, strategies, and services within an organization. Digital platforms, which encompass various tools and structures, including social broadcasting, cloud computing, and collaborative software, have become essential for contemporary organizational initiatives (Ardi et al., 2020). These platforms facilitate unified collaboration, continuous communication, and knowledge exchange across diverse structural levels, fostering an atmosphere conducive to innovation (Ackermann et al., 2015). Although the significance of digital platforms is well recognized, their role in executive outcomes, particularly in terms of e-knowledge expansion and innovation, remains underexplored. This research aims to address this gap by examining the relationship between digital platforms and e-knowledge and its impact on organizational innovativeness.

AI adoption has emerged as a crucial dynamic in determining organizational innovativeness. AI tools enable enterprises to process significant volumes of data, identify patterns, and generate insights that inform strategic decision-making and enhance operational efficiencies (Drewniak & Posadzińska, 2019). The integration of AI technologies into administrative practices has significantly improved big data analytics capability, which is a critical factor for enterprises striving to remain competitive in data-driven environments (Upadhyay et al., 2023). Despite the growing body of research on AI adoption, there is limited insight into the direct impacts of AI on big data analytics capability and the subsequent contribution of big data analytics capability to innovativeness (Fajimolu et al., 2023). Hence, this research seeks to fill this gap by inspecting the direct relationship between AI adoption and big data analytics capability, as well as the latter's influence on organizational innovativeness.

The concept of e-knowledge refers to the creation, storage, and dissemination of knowledge within an enterprise through digital means (Alotaibi et al., 2014). As enterprises progressively rely on digital platforms to manage their data and information resources, understanding the role of e-knowledge in fostering innovativeness becomes critical (Chen, 2014). Existing studies suggest that e-knowledge is a significant facilitator of innovation because it equips employees with the systems and technologies necessary to create novel ideas (Mureşan & Gogu, 2010). Additionally, big data analytics capability supports an enterprise in evaluating and utilizing large data sets to enhance understanding and make informed decisions that can lead to creative outcomes (Song et al., 2020). It is recognized as another pivotal mediator that can enhance innovativeness (Jaouadi, 2022). While existing researchers have explored the role of big data analytics capability in organizational success, the specific pathway through which big data analytics capability facilitates the link between AI adoption and organizational innovativeness remains underexplored (Karaboğa et al., 2019; Waqas &Tan, 2023). Consequently, this research aims to enrich the existing literature by examining this mediating effect and emphasizing the importance of significant data analytics capabilities in leveraging AI tools for innovativeness.

This study also emphasizes the moderating role of strategic flexibility in enhancing e-knowledge and big data analytics capability in the context of digital platforms and AI adoption. Strategic flexibility refers to an enterprise's ability to adjust its strategies in response to changing environments and acts as a regulator in the relationships between digital platforms, AI adoption, and organizational innovativeness (Yablonsky, 2020). Enterprises exhibiting a high degree of strategic flexibility are better equipped to leverage the potential of digital platforms and AI technologies, thereby strengthening their innovative capabilities (Matalamäki & Joensuu-Salo, 2022). While strategic flexibility is widely acknowledged because it is a critical factor in organizational success, further empirical investigation is required to explore how strategic flexibility enhances the impact of digital platforms and AI adoption on innovativeness (Li & Wang, 2023). Consequently, this study investigates the moderating effects of strategic flexibility and its significant role in supporting the relationship between AI adoption and big data analytics capability.

Despite the growing body of literature on digital platforms and AI adoption, there remains a noteworthy gap in understanding precisely how these tools and capabilities interrelate to stimulate organizational innovativeness, particularly through mediations such as e-knowledge and big data analytics capability. Prior research has primarily focused on the direct effects of digital platforms (e.g., Ben Arfi & Hikkerova, 2021; Calabrese et al., 2021; Ruiz-Alba et al., 2022) and AI adoption (e.g., Bahoo et al., 2023; Haefner et al., 2021; Hamm & Klesel, 2021), yet few have examined the intricate indirect pathways through which these tools and technologies influence organizational innovativeness (e.g., Saide & Sheng, 2020; Zhou et al., 2020). Notably, the mediating roles of e-knowledge and big data analytics capability and the moderating role of strategic flexibility have not been comprehensively explored from the lens of innovation. This research adds to the existing literature by providing an inclusive examination of these linkages, offering novel insights into the multifaceted interactions among digital platforms, AI adoption, and organizational innovativeness while emphasizing the significant roles of e-knowledge, big data analytics capability, and strategic flexibility. By addressing these gaps, this research enhances the present understanding of how enterprises can better leverage technological strategies and AI tools to foster organizational innovativeness, ultimately implementing more effective strategies for enhancing innovativeness in different organizational contexts. The research structure includes a detailed literature review establishing the basis for suggested hypotheses, followed by an outlining of the study design and analytical techniques utilized. Subsequently, the results are elaborated, leading to a discussion of outcomes, their implications, and recommendations for future studies.

Literature review

Dynamic capabilities theory

Dynamic capabilities theory was introduced by Teece et al. (1997) to elucidate an enterprise's cultivation, adjustment, and reconfiguration of its capabilities and resources to achieve long-term competitive advantages (Bleady et al., 2018; Lawson & Samson, 2001). This theory is highly relevant to the current study's research model, focusing on an enterprise's aptitude for developing competencies to address rapidly shifting dynamics. From this research's perspective, digital platforms and AI adoption are crucial dynamic competencies that support an enterprise in effectively acquiring, utilizing, and leveraging e-knowledge and big data analytics capability to enhance innovativeness. Similarly, e-knowledge, supported by digital platforms, aligns with the dynamic capabilities of data integration, and big data analytics capability reflects an enterprise's capability to leverage big data for strategic decision-making, a vital aspect of the various skills in data-driven environments. Strategic flexibility, another pivotal concept in dynamic capabilities theory, is a moderating factor that enhances an enterprise's ability to adjust its strategies in line with external changes, thereby strengthening the relationships among digital platforms, AI adoption, and organizational innovativeness. Dynamic capabilities theory offers a robust theoretical lens through which the interactions of these constructs can be understood, highlighting the importance of adaptability and resource reconfiguration in achieving sustained innovativeness.

Knowledge-based view

The knowledge-based view of firms builds upon and extends the resource-based view proposed by Penrose in 1959 (Penrose, 1995) and expanded by Wernerfelt (1984) and Conner (1991). A firm's resource-based view recognizes the role of knowledge for the competitive position within a particular industry and treats it like a generic

resource. In contrast, proponents of the knowledge-based view argue that the resource-based view does not adequately consider the special characteristics and strategic significance of knowledge resources, which are vital for organizational production, exchange, and creativity (Grant, 1996). The knowledge-based view highlights the strategic role of knowledge in learning, creativity, inter-firm collaboration, and new product development. In this respect, digitalization plays a critical role in enhancing an organization's knowledge-based view with information technologies, enabling the synthesis, enhancement, and utilization of valuable information (Cooper et al., 2023). This theory is relevant to the current research because it focuses on an enterprise's ability to utilize emerging technologies to address rapidly shifting dynamics. From this research's perspective, digital platforms and AI adoption are crucial dynamic competencies that enable an enterprise to acquire exchange and utilize e-knowledge and data. E-knowledge, supported by digital platforms, aligns with the dynamic capabilities of data integration. Knowledge-based view offers a resilient theoretical framework through which the interaction of digital platforms and e-knowledge can be understood, emphasizing the significance of knowledge sharing and resource reconfiguration in achieving sustained innovativeness.

Diffusion of innovation theory

Diffusion of innovations theory, introduced in 1962 by Everett Rogers, elucidates how, why, and in what ways new technology and ideas spread (Huong & Duc, 2023). Proponents of this theory assert that diffusion involves the process by which certain channels enable participants within a social system to communicate and adopt innovations. This theory aligns with the current research because it emphasizes an enterprise's capacity to adopt advanced technologies and foster the exchange of new ideas among organizational members. In this context, digital platforms and AI adoption can be viewed because crucial dynamic competencies support an enterprise in acquiring, utilizing, and leveraging e-knowledge and big data analytics capability effectively to enhance innovativeness (Wang et al., 2023). Diffusion of innovations theory offers a robust theoretical framework through which the adoption of new ideas and practices becomes crucial, highlighting the significance of digitalization in determining an organization's innovation activities.

Digital platforms and organizational innovativeness

The term digital platforms refers to the use of digital technologies to exchange and distribute information among individuals, enabling the acquisition and capitalization of information for value creation (Nambisan et al., 2019). Digital platforms encompass the infrastructure through which enterprises manage and disseminate knowledge and data (Khin & Ho, 2019). These infrastructures provide dynamic and interconnected environments where data can be segmented, accessed, and appraised in real time across different organizational levels (Cenamor et al., 2019). Digital platforms are essential for promoting e-knowledge, which generates, accumulates, and facilitates collaborative digital information within an enterprise (Medina-Molina et al., 2019). By simplifying the seamless flow of data and enhancing collaboration among employees, digital platforms upgrade the enterprise's capacity to create and leverage e-knowledge (Khin & Ho, 2019). Consequently, it is anticipated that enterprises that effectively utilize and promote digital platforms are likely to experience essential advancements in their e-knowledge. Moreover, digital platforms provide technologies and systems that enable an enterprise's continuous learning and data acquisition practices (Anwar et al., 2022; Sedera et al., 2016). The communicative aspects of digital platforms, including discussion forums, social networks, and collaborative workspaces, contribute to the advancement of e-knowledge by facilitating employee engagement in sharing insights, discussions, and collaboration on projects (Cenamor et al., 2019). Therefore, the adoption of digital platforms is expected to lead to more informed employees, which in turn is expected to reinforce the enterprise's overall knowledge administration abilities (Ardi et al., 2020). This leads to the current study's first hypothesis:

H1: There is a positive association between digital platforms and organizational innovativeness.

Artificial intelligence adoption and organizational innovativeness

AI adoption is transforming the landscapes of data analysis, particularly within the realm of big data (Mikalef& Gupta, 2021). Enterprises are increasingly relying on AI tools to process vast amounts of information, extract meaningful insights, and support decision-making initiatives (Gupta et al., 2022). The capacity for AI adoption helps in considering unstructured data, identifying patterns, and forecasting trends that enhance an enterprise's big data analytics capability (Dubey et al., 2020). AI-driven analytics technologies can generate information at an exceptional speed, revealing unseen links and providing actionable insights that may be challenging, if not impossible, to obtain through customary data analytics methods (Rubel et al., 2023). Therefore, enterprises that adopt AI are expected to experience significant enhancements in their big data analytics capability.

Additionally, AI tools facilitate the automation of data analytics tasks, reducing the timeline and effort required to process large data sets (Verganti et al., 2020). This automation enhances efficiency and improves the accuracy and consistency of data analytics outcomes (Drewniak & Posadzińska, 2019). By integrating AI into data analysis processes, enterprises can manage and evaluate big data, leading to informed strategic decision-making (Mikalef & Gupta, 2021). The analytical capabilities of AI tools driven by mechanism algorithms allow enterprises to anticipate market developments, consumer behavior, and prospective risks, thereby enhancing their overall big data analytics capability (Li et al., 2019). Consequently, AI adoption is strongly linked to advancing an enterprise's capacity to analyze and leverage big data analytics. This leads to the current study's second hypothesis:

H2: AI adoption has a positive connection with big data analytics capability.

E-Knowledge and organizational innovativeness

E-knowledge is concerned with the ability of an individual to identify, acquire, incorporate, and leverage knowledge from external sources integrated into an organization-wide knowledge management network (Al-Husseini, 2024). E-knowledge is critical in determining an organization's innovation (Gunsel et al., 2011). Because enterprises increasingly operate in a digital environment, the capability to acquire and exploit e-knowledge is essential for enhancing innovativeness (Mansoor & Ratna, 2014). E-knowledge encompasses the vast collection of digital data, insights, and proficiency that an organization accumulates over time (Chen, 2014). In a rapidly changing environment, enterprises must adapt swiftly to new challenges, developments, and trends (Nawaz et al., 2019). E-knowledge provides vital information and perspectives for creating strategic decisions that support the enterprise's innovation objectives (Fallatah, 2019).

Moreover, by utilizing an efficient and readily accessible knowledge and information base, enterprises can reduce the time spent searching for information allowing the workforce to focus on generating innovative ideas and implementing creative strategies (Alotaibi et al., 2014). Additionally, the collaborative nature of knowledge exchange fosters a culture of continuous learning and innovation, where employees are encouraged to contribute to and build upon the organization's existing knowledge base (García-Sánchez et al., 2018). Enterprises that effectively generate and apply their e-knowledge are better positioned to innovate and remain competitive in their respective industries (Chen, 2014). This research proposes that enterprises with robust e-knowledge

capabilities are likely to exhibit high levels of structural innovativeness, ultimately leading to sustained success and growth in the market. This leads to the current study's third hypothesis:

H3: E-knowledge is significantly and positively linked to organizational innovativeness.

Big data analytics capability and organizational innovativeness

Big data analytics capability has emerged as a vital factor in determining innovativeness (Alkhatib & Valeri, 2024). Big data analytics capability refers to an organization's aptitude to efficiently gather processes and analyze large volumes of complex data to develop actionable insights (Ciampi et al., 2021). In the contemporary data-driven world, organizations that excel in big data analysis can uncover emerging patterns, trends, and correlations that are not immediately apparent, leading to informed strategic decision-making, optimized processes, and the development of innovative services (Song et al., 2020). By leveraging big data analytics capability, organizations can recognize consumer demands, anticipate market shifts, and identify novel prospects for innovation, thereby enhancing their innovativeness (Fajimolu et al., 2023).

Furthermore, the speed and accuracy with which enterprises can analyze information can provide a substantial competitive advantage enabling them to respond swiftly to market changes and innovate more effectively (ZareRavasan, 2023). By incorporating advanced analytic technologies such as machine learning and predictive modeling, enterprises can test various scenarios and evaluate the potential of innovative concepts before implementation (Lozada et al., 2023). Assessing and understanding big data allows organizations to differentiate themselves from competitors by continuously innovating in response to emerging trends and customer demands (Alkhatib & Valeri, 2024). This study suggests that big data analytics capability is a significant determinant of organizational innovativeness, contributing to the organization's long-term success and adaptability to rapidly changing market dynamics. This leads to the current study's fourth hypothesis:

H4: Big data analytics capability is positively linked with organizational innovativeness.

Mediating role of e-knowledge

Digital platforms are increasingly recognized as a key tool for improving organizational data management, particularly in relation to e-knowledge (Singh et al., 2024). These platforms facilitate the effective collection, storage, and dissemination of e-knowledge across enterprises, enabling the workforce to access, acquire, and utilize data effortlessly (Nawaz et al., 2019; Tajpouret al., 2022). E-knowledge represents collaborative digital knowledge within an organization, and it is fundamental to enhancing organizational innovation (Gunsel et al., 2011). Organizations can build a connected and updated workforce through digital platforms where employees can easily collaborate and exchange ideas and concepts (Tran-Thi-Thanh, 2024). E-knowledge connects an organization's use of technological platforms with its ability to innovate (Mansoor & Ratna, 2014). When employees leverage e-knowledge available through technological platforms, they can draw on a broader range of expertise and insights, leading to more informed decision-making and innovative problem-solving (Chen, 2014). Consequently, e-knowledge becomes a pivotal mediator that enriches the influence of technological platforms on the organization's innovation by ensuring that the data collected is efficiently utilized to inspire and stimulate innovative ideas (García-Sánchez et al., 2018). Therefore, it is proposed that e-knowledge mediates the relationship between digital platforms and organizational innovativeness, amplifying the positive impacts of digital platforms on innovative outcomes. Integrating digital platforms and e-knowledge management initiatives is essential for nurturing organizational principles (Karaboğa et al., 2019). This leads to the current study's fifth hypothesis:

H5: The relationship between digital platforms and organizational innovativeness is mediated through e-knowledge.

Mediating role of big data analytics capability

AI adoption has become a transformative force within organizations, determining effectiveness and facilitating more informed decision-making (Drewniak & Posadzińska, 2019). However, the direct impacts of AI adoption on organizational creativity are often recognized through its implications for big data analytics capability (Ciampi et al., 2021). Big data analytics capability refers to an organization's ability to process and analyze vast amounts of information to generate actionable insights (ZareRavasan, 2023). AI technologies enhance big data analytics capability by automating complex data analytics tasks, identifying patterns in large data sets, and providing predictive insights that may be difficult to derive through traditional methods (Waqas & Tan, 2023). When an organization adopts advanced AI tools, its enhanced big data analytics capability becomes a critical intermediary enabling it to leverage data-driven insights to increase innovativeness (Robins & Gready, 2022). The pivotal mediating role of big data analytics capability in the relationship between AI adoption and organizational innovativeness is significant. While advanced AI tools provide essential data processing and analysis services, an organization's ability to utilize these AI tools, along with big data analytics capability, effectively determines its innovative outcomes (Lozada et al., 2023). AI-enabled big data analytics capability allows organizations to experiment with new ideas, validate hypotheses, and elevate decision-making processes based on data-driven insights (Kuo, 2024). Moreover, this competency not only enhances the quality and speed of innovation but also reduces the risks associated with introducing innovative products, services, and practices (Awan et al., 2022). Thus, the positive influence of AI adoption on organizational innovativeness is facilitated by an organization's proficiency in leveraging big data analytics capability to generate creative outcomes (Alkhatib & Valeri, 2024). This mediating role underscores the significance of embracing AI tools and enhancing critical analytics capabilities to transform AI-driven information into actionable innovative strategies (Chatterjee et al., 2023). Accordingly, this study posits that big data analytics capability is a vital factor that bridges the gap between AI adoption and organizational innovativeness, ensuring that AI's potential is fully realized with increasing innovativeness. This leads to the current study's sixth hypothesis:

H6: The relationship between AI adoption and organizational innovativeness is mediated through big data analytics capability.

Moderating role of strategic flexibility

Digital platforms have become essential for promoting organizational innovation by facilitating collaboration, information sharing, and rapid dissemination of information (García-Sánchez et al., 2018). Digital platforms assist organizations in streamlining their practices, enhancing communication, and fostering a culture of continuous improvement and innovation (Mansoor & Ratna, 2014). However, the extent to which digital platforms contribute to structural creativity may vary depending on the enterprise's strategic flexibility (Zahoor & Lew, 2023). Strategic flexibility enhances an enterprise's competence to adapt and respond to external environmental changes, including marketplace dynamics, technological advancements, and economic pressures (Muneeb et al., 2023). Organizations with higher strategic flexibility are better positioned to leverage the capabilities provided through digital platforms to drive innovation (Gunsel et al., 2011). The moderating role of strategic flexibility in the relationship between digital platforms and e-knowledge is crucial. It is posited that organizations with high levels of strategic

flexibility are likely to experience stronger positive impacts of digital platforms on innovative outcomes (Al-Momani et al., 2023). Organizations that can swiftly align their strategies and plans with the opportunities presented by technological platforms are well-prepared to innovate, adapt, and maintain a competitive advantage in their respective industries (Nawaz et al., 2019). Flexible organizations can employ technological platforms to implement new ideas rapidly, respond to emerging trends, and explore innovative solutions. Consequently, strategic flexibility is a pivotal moderator that intensifies the benefits of technological platforms in enhancing e-knowledge (Chanphati & Thosuwanchot, 2023). This leads to the current study's seventh hypothesis:

H7: Strategic flexibility amplifies the relationship between digital platforms and e-knowledge.

AI adoption has become increasingly essential for organizations seeking to enhance their big data analytics capability (Chanphati & Thosuwanchot, 2023). AI technologies assist organizations in developing vast amounts of information, identifying patterns, and generating insights that inform improved decision-making and strategic forecasting (Drewniak & Posadzińska, 2019). However, the organization's strategic flexibility influences the degree to which AI adoption translates into big data analytics capability (Lozada et al., 2023). Furthermore, organizations with higher strategic flexibility are better equipped to adjust their practices, structures, and resources to fully harness the potential of AI technologies and tools, thereby strengthening the relationship between AI adoption and big data analytics capability (Ciampi et al., 2021).

Moreover, AI tools offer powerful capabilities for data analytics, and their effectiveness depends on how well an organization can assimilate these tools into its existing frameworks and workflows (Robins &Gready, 2022). Organizations with flexibility can adapt their data management practices, leverage new AI-powered analytics technologies, and retrain their employees to better utilize AI-generated insights (Awan et al., 2022). This flexibility ensures that the full potential of AI technologies is realized through enhanced big data analytics capability (ZareRavasan, 2023). Hence, this hypothesis suggests that while AI adoption is critical for cultivating robust data analytics capabilities, its impact is significantly intensified when supported by an organization's ability to adapt, adjust, and progress in response to technological advancements. This leads to the current study's eighth hypothesis:

H8: The relationship between AI adoption and big data analytics capability is strengthened through strategic flexibility.

Theoretical framework

Fig. 1 illustrates the association among the study's constructs. The current study employs six variables: digital platforms, AI adoption, e-knowledge, big data analytics capability, strategic flexibility and organizational innovativeness. Digital platforms and AI adoption are assumed to directly predict e-knowledge and big data analytics capability, with strategic flexibility assumed to serve a moderating variable in these connections. Organizational innovativeness is used as the outcome variable in the current study.

Methodology

The research explores the linkages among digital platforms, AI adoption, big data analytics capability, e-knowledge, strategic flexibility, and organizational innovativeness from the perspectives of educational institutions. It used correlation coefficients and structural equation modeling (SEM) to test the study hypotheses in this cross-sectional design study. A correlation analysis was performed to verify the associations between the study constructs. The value of the coefficient of correlations determined the degree to which one variable depended on another and the nature of the association between components in a one-to-one arrangement. Following the confirmation of directionality, an SEM analysis was conducted to determine the degree and significance of a variable's dependence on another.

Sampling and data collection

The target population consisted of educational institutions. The key determining factors of organizational innovation were the adoption of advanced digital applications and the workforce's ability to demonstrate

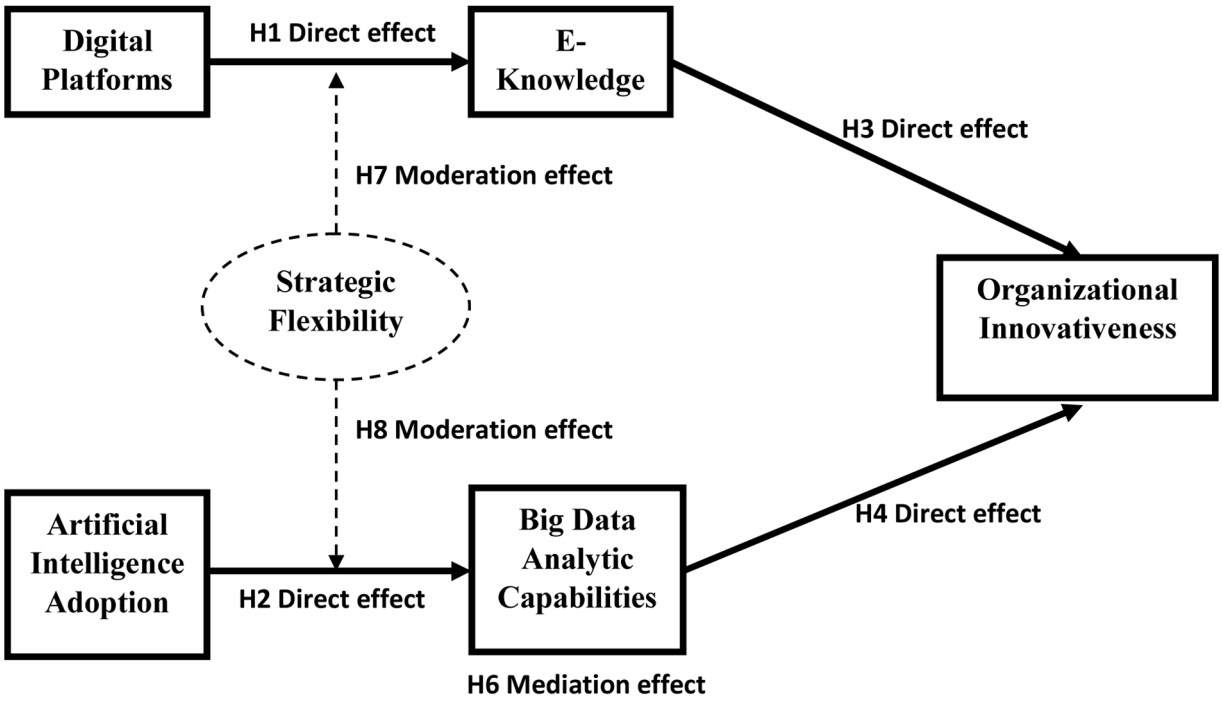

Fig. 1. Theoretical framework.

digital flexibility, which fosters confidence and ethical use of online applications. The strength of the current research lies in the generalizability of the outcomes derived from a relatively small sample size. The samples were selected based on three criteria. First, they must utilize advanced technological resources and information technology (IT)-based educational practices. Second, they should regularly adopt and form IT tools within their institutes. Third, they must operate and launch the latest software in emerging markets. The sample size for this research comprised 550 respondents chosen through a stratified random sampling method to represent diverse divisions and roles within educational institutions. Respondents were selected based on their involvement in using digital platforms, adopting AI tools, and employing structurally innovative practices. For the survey, structured questionnaires were employed to gauge respondents' insights regarding the variables under investigation; these questionnaires were electronically distributed by e-mail or other applications with the assistance of five research associates.

Before distributing the survey, two academics and three experts reviewed the survey to ensure clarity. The responses were collected from the respondents who provided informed consent over one and a half months. The research yielded a robust data set using 399 valid responses after carefully cleaning the data to eliminate outliers and incomplete questionnaires. A response rate of 72.54 % was considered a good sample size. Demographic data regarding education level, work experience, and age (ranging from 22 to 50 years) were collected and analyzed. The survey was distributed in two halves to reduce consistency error rates and participant fatigue. Section 1 included the items used for the study variables, while Section 2 comprised information about demographic aspects, including age, qualifications, and work experience.

Measurements

The research constructs were measured using validated items from existing studies, which were adjusted to the context of educational institutions to assess the dimensions' accuracy, consistency, and relevance. A five-point Likert scale was utilized to evaluate the items, with scores ranging from 1 (strongly disagree) to 5 (strongly agree). The measuring variables discussed are as follows.

Digital platforms

An eight-point scale adapted from Mathmann et al. (2017) was used to measure digital platforms. This construct evaluated the degree of utilization and effectiveness of technological tools, devices, and systems for collaboration, communication, and information exchange within an institute. The questionnaire item was, "Our platform can facilitate real-time information exchange with our customers and partners."

AI adoption

AI adoption was measured using a nine-point scale adapted from Hatlevik & Bjarnø (2021). This concept measures how an enterprise accepts, implements, and integrates AI tools into its decision-making practices and educational activities. An example item was, "AI adoption is more cost-effective than other technologies."

E-knowledge

E-knowledge was measured using a six-point scale adapted from Chen et al. (2011). This construct gauged an institution's ability to generate, collect, and disseminate technological knowledge effectively. An example item was, "The e-learning system helps users understand how they protect their information."

Big data analytics capability

A seven-point scale, adapted from the works of Binsaeed et al. (2023) and Mikalef et al. (2019), was employed to measure big data analytics capability. This variable assessed an enterprise's ability to examine, understand, and exploit large data sets for strategic decision-making. An example item was, "I can access extensive, unstructured, or fast-moving data for analysis."

Strategic flexibility

A four-point scale derived from Kozjek and Ferjan (2015) was used to measure strategic flexibility. This variable evaluated an enterprise's ability to handle and adjust its actions and strategies in response to changing market conditions. An example item was "The capability of an organization to adjust its operations by reducing the number of employees."

Organizational innovativeness

Organizational innovativeness was evaluated using a four-point scale modified by Hsu (2007). This construct assessed an institution's capability to create, implement, and withstand novel processes, ideas, and technologies. An example item was "The ability of the firm to design innovative products and services."

Results

Confirmatory factor analysis

Confirmatory factor analysis (CFA) was employed to investigate the relationships among the study's constructs: digital platforms, e-knowledge, AI adoption, big data analytics capability, strategic flexibility and organizational innovativeness. The model fit indices for the four-factor model indicated satisfactory fit, with $\chi^2 = 1024.68$, df = 459, χ^2/df= 2.22, CFI = 0.95, GFI = 0.96 and RMSEA = 0.05, demonstrating general model competency (Table 1). All values were significant and met the threshold levels.

Discriminant and convergent validity

Table 2 presents the outcomes of the convergent and discriminant validity analysis. Discriminant validity was assessed using the heterotrait-monotrait (HTMT) ratio and AVE (Fornell & Larcker, 1981a; Fornell & Larcker, 1981b). The findings show that the factor loading values were greater than 0.70, while the average variance extracted was higher than 0.50. Additionally, the composite reliability (CR) was higher than 0.60, and the outcomes of the Cronbach alpha were above 0.70.

Correlation

Table 3 indicates the outcomes of the standard deviation (SD), mean, and correlation matrix. The findings revealed that digital platforms have a significant positive correlation with e-knowledge (0.21) and organizational innovativeness (0.23). Moreover, the results also revealed that AI adoption has a significant direction towards big data analytics capability (0.24) and organizational innovativeness (0.38). Additionally, both e-knowledge and big data analytics capabilities were significant and directed toward organizational innovativeness (0.25 and 0.26, respectively). Furthermore, strategic flexibility also demonstrated a significant positive correlation with organizational innovativeness (0.24).

Table 1
Confirmatory factor analysis.

Model Detail	χ2	Df	χ2/df	RMSEA	GFI	CFI
Four-factor model	1378.54	654	2.11	0.04	0.91	0.92
Three-factor model	1254.12	352	3.56	0.08	0.87	0.86
Two-factor model	1456.76	381	3.82	0.07	0.79	0.78
One-factor model	1489.21	360	4.14	0.06	0.65	0.66

Source: Research results

Table 2
Convergent and discriminant validity.

Details	Alpha	CR	AVE	F Loading
Digital platforms	0.93	0.94	0.77	0.71 -0.89
E-knowledge	0.94	0.95	0.72	0.70 -0.88
AI adoption	0.85	0.90	0.69	0.71 -0.86
Big data analytics capability	0.93	0.94	0.66	0.69 -0.85
Strategic flexibility	0.91	0.94	0.84	0.73 -0.87
Organizational innovativeness	0.96	0.97	0.85	0.72 - 0.83

Source: Research results

Hypothesis testing

SEM was utilized to examine the direct impact of digital platforms on e-knowledge, and H1 was accepted ($\beta = 0.28$, $p < 0.000$). Additionally, AI adoption was significantly linked with organizational innovativeness ($\beta = 0.18$, $p < 0.000$), thereby supporting H2. The results are presented in Table 4.

Outcomes of the mediating role of e-knowledge

E-knowledge mediates the relationship between digital platforms and organizational innovativeness (digital platforms → E-knowledge → organizational innovativeness). Using the Preacher and Hayes (2008) analysis process, the present study results confirmed the indirect impacts of e-knowledge on digital platforms and organizational innovativeness ($\beta = 0.22$, $L = 0.2891$ to $U = 0.2922$) as presented in Table 5.

Outcomes of the mediating role of big data analytics capability

Big data analytics capability mediates the relationship between AI adoption and organizational innovativeness (AI adoption → big data analytics capability → organizational innovativeness). The outcomes showed that big data analytics capability positively mediates the relationship between AI adoption and organizational innovativeness ($\beta = 0.31$, $L = 0.2081$ to $U = 0.2103$; Table 6).

Strategic flexibility moderates the relationship between digital platforms and e-knowledge

A two-step regression analysis was employed to check the moderation effect. The results confirmed that strategic flexibility enhances the impact of digital platforms on e-knowledge, thus moderating the relationship between the digital platforms and e-knowledge (Table 7).

Strategic flexibility moderates the relationship between AI adoption and big data analytics capability

The two-step regression analysis confirmed that strategic flexibility enhances the impact of AI adoption on big data analytics capability, thus moderating the relationship between AI adoption and big data analytics capability (see Table 8).

Discussion

This research's findings illuminate the complex associations among digital platforms, AI adoption, e-knowledge, big data analytics capability, strategic flexibility, and organizational innovativeness. First, the results support the notion that digital platforms are positively associated with the advancement of e-knowledge within an institution, thereby validating H1 and underscoring the importance of digital platforms in fostering a collaborative and informed workplace. This finding aligns with previous studies that highlight digital platforms' transformative effect on the management and dissemination of knowledge and data in enterprises (Khin & Ho, 2019). Technological platforms provide dynamic and interconnected environments where data can be segmented, accessed, and appraised in real time across various organizational levels (Cenamor et al., 2019). This capability is necessary for promoting e-knowledge, which generates, accumulates, and facilitates collaborative digital information within an enterprise (Medina-Molina et al., 2019). Second, AI adoption is found to be directly linked with big data analytics capability (H2), reinforcing the assertion that AI tools are vital in handling big data sets and extracting valuable insights that can drive innovation. This findings aligns with existing research, which indicates that AI tools facilitate the automation of data analytics tasks, reducing the timeline and effort required to process large data sets (Verganti et al., 2020). This automation enhances efficiency and improves the accuracy and consistency of data analytics outcomes (Drewniak & Posadzińska, 2019). By integrating AI into data analysis procedures, enterprises can effectively manage and evaluate big data, leading to informed strategic decision-making (Mikalef & Gupta, 2021).

Furthermore, this research shows that both e-knowledge and big data analytics capability play a substantial role in enhancing organizational innovativeness. E-knowledge contributes to innovation by providing the workforce with essential resources and information to implement novel ideas and solutions. Similarly, big data analytics capability enables an enterprise to leverage data-driven insights to inform strategic choices and optimize processes. These findings support existing studies that highlight the critical role of digitalized sources of an institution's collaborative e-knowledge in driving organizational innovation (Gunsel

Table 3
Correlation.

Construct	Details	Mean	SD	1	2	3	4	5	6
1	Digital platforms	3.11	0.75	1.00					
2	E-knowledge	1.75	0.83	0.21**	1.00				
3	AI Adoption	3.68	0.79	0.19*	0.13*	1.00			
4	Big data analytics capability	3.50	0.85	0.15*	0.12*	0.24**	1.00		
5	Strategic flexibility	3.35	0.64	0.17*	0.10*	0.35**	0.33**	1.00	
6	Organizational innovativeness	3.20	0.81	0.23**	0.25**	0.38**	0.26**	0.24*	1.00

Note: * $p < 0.05$, two-tailed; ** $p < 0.01$; Source: Research results

Table 4
Direct effect.

Details		B	F	t-value	P	Remarks
H1	Digital platforms →E-knowledge	0.19**	11.341	6.511	0.000	Accepted
H2	AI adoption → Big data analytics capability	0.32**	14.119	8.923	0.000	Accepted
H3	E-knowledge→organizational innovativeness	0.26**	18.142	9.143	0.000	Accepted
H4	Big data analytics capability →organizational innovativeness	0.28**	37.361	10.821	0.000	Accepted

Note: ** sig p = 0.000; Source: Research results

Table 5
Indirect effect of E-knowledge.

Model Description	Data	Boot	SE	L.V	U.V	Sig
Digital platforms →E-knowledge→organizational innovativeness	0.22	0.23	0.09	0.2891	0.2922	0.000

Source: Research results

Table 6
Indirect effect of big data analytics capability.

Model Description	Data	Boot	SE	L.V	U.V	Sig
AI adoption→ big data analytics capability → organizational innovativeness	0.31	0.32	0.13	0.2081	0.2103	0.000

Source: Research results

Table 7
Regression results of moderation effects of strategic flexibility on digital platforms and e-knowledge.

Factors and Research Resumes	Model-1		Model-2	
	β	t-value	B	t-value
Digital platforms	0.19**	6.542	0.23**	5.318
Strategic flexibility	0.14*	3.561	0.28***	6.147
Digital platforms x strategic flexibility			0.271**	14.241
*Model-1 Resumes (R = 0.29**,ΔRsq = 0.19, F = 34.543)*				
*Model-2 Resumes (R = 0.33**,ΔRsq = 0.22, F = 38.821)*				

Note: Significance level **p< 0.001, *p<0.01. Source: Research results

Table 8
Regression results of moderation effects of strategic flexibility on AI adoption and big data analytics capability.

Factors and Research Resumes	Model-1		Model-2	
	B	t-value	B	t-value
AI Adoption	0.22**	9.515	0.24**	9.238
Strategic flexibility	0.18*	5.629	0.28***	10.371
AI adoption x strategic flexibility			0.253**	18.534
*Model-1 Resumes (R = 0.31**,ΔRsq = 0.21, F = 44.234)*				
*Model-2 Resumes (R = 0.36**,ΔRsq = 0.23, F = 39.543)*				

Note: Significance level **p< 0.001, *p<0.01. Source: Research results

et al., 2011). Because enterprises increasingly operate in a digital setting, achieving and exploiting e-knowledge becomes essential for boosting innovativeness (Mansoor & Ratna, 2014). Moreover, the mediating effects of e-knowledge and big data analytics capability further reveal that these capabilities are crucial for maximizing the benefits of technological platforms and AI adoption. By effectively leveraging e-knowledge and big data analytics capability, enterprises can enhance their capacity for innovation, thereby achieving competitive advantages in a rapidly evolving environment.

In conclusion, this research highlights the crucial role of strategic flexibility in regulating the linkages between digital platforms, AI adoption, and organizational innovativeness. The findings demonstrate that strategic flexibility enhances the effect of digital platforms on organizational innovativeness by facilitating institutions' adjustments of their policies and activities in response to novel opportunities. Furthermore, the outcomes support previous studies indicating that flexible organizations can adapt their information management processes, capitalize on novel AI-powered analytical technologies, and retrain their employees to better exploit AI-generated insights (Awan et al., 2022). This flexibility ensures that the full potential of AI technologies is recognized through enhanced big data analytics capability (ZareRavasan, 2023). Likewise, strategic flexibility improves the relationship between AI adoption and big data analytics capability, enabling enterprises to fully integrate AI tools and technologies into their operations, thereby maximizing their data analysis capabilities. These outcomes support previous studies asserting that AI adoption has become increasingly essential for enterprises seeking to enhance their data analysis competencies (Chanphati & Thosuwanchot, 2023). AI technologies assist institutions in generating vast amounts of information, identifying patterns, and deriving insights that inform enhanced decision-making and strategic forecasting (Drewniak & Posadzińska, 2019). These findings suggest that strategic flexibility is a key enabler of innovation, amplifying the positive effects of digital platforms and AI adoption on organizational innovativeness. Organizations that cultivate strategic flexibility are better positioned to leverage technological advancements and drive continuous innovation, ensuring long-term success and adaptability.

Theoretical implications

These research outcomes provide substantial theoretical insights into the interaction among digital platforms, AI adoption, and organizational innovativeness, primarily through the mediating roles of big data analytics capability and e-knowledge and the moderating effects of strategic flexibility. First, this study contributes to dynamic capabilities theory and the knowledge-based view by illustrating how digital platforms and AI adoption serve like foundational elements for developing big data analytics capability and e-knowledge. This research proposes that the effectiveness of these tools and the latest technologies in enhancing logistic innovation is not merely a direct effect but is significantly influenced by the institution's ability to acquire and utilize the data insights generated. The current study extends diffusion of innovations theory by emphasizing the importance of examining digital platforms and AI as enablers that facilitate operational knowledge and management processes to understand their potential in determining innovativeness.

SEcond, this research presents strategic flexibility as a moderating factor that amplifies the influence of the digital platforms and AI adoption on organizational innovativeness. This adds a novel dimension to existing theories of strategic management and innovation by highlighting the prominence of an organization's capability to adapt and reconfigure its strategies according to technological advancements and environmental changes. Furthermore, this study reinforces the theoretical understanding that innovativeness relies not only on adopting the latest technologies but also on the organization's strategic capabilities.

Practical implications

The current research outcomes offer actionable insights for institutions looking to enhance innovation through strategic technical platforms and AI tools. First, enterprises must focus on establishing resilient digital platforms that facilitate the conception and exchange of e-knowledge, which is closely linked to improved organizational innovativeness. Management should leverage technological tools that promote unified collaboration, seamless communication, and effective data management to maximize the creative potential of their workforce. Scond, AI adoption should align with big data analytics capability; enterprises must ensure their AI initiatives are integrated with their data analysis strategies to fully leverage AI's potential.

The findings also suggest that organizations' ability to adapt their capabilities and strategies to advancements in technologies and emerging market conditions plays a crucial role in positively responding to rapid advancements in digital technologies and AI. Strategic

flexibility organizations can quickly and rapidly reconfigure processes, resources, and priorities for integrating AI and digital platforms. Organizations should emphasize flexibility in their strategies to adopt, integrate, and scale emerging technologies including digital platforms and AI to gain innovative and competitive advantages. By doing so, they can amplify the impact of digital platforms and AI adoption on their innovation outcomes, ensuring sustained progress and competitiveness in increasingly dynamic environments.

Moreover, this research underscores the significance of strategic flexibility in capitalizing on the advantages of digital platforms and AI adoption. Enterprises that foster strategic flexibility possess the capability to swiftly adapt to technological advancements and market dynamics, leading to enhanced organizational innovativeness. This indicates that enterprises should invest in technology and cultivate an organizational culture that supports rapid adoption and strategic agility.

Limitations and future directions

While this research provides valuable insights into the relationships among digital platforms, AI adoption, big data analytics capability, strategic flexibility, e-knowledge, and organizational innovativeness, its limitations must also be acknowledged. One constraint is the potential variability in the adoption and integration of advanced technologies across different sectors and contexts, which may affect the generalizability of the findings. Additionally, the cross-sectional design of this study limits the capacity to infer causality among constructs. Future research could address these limitations by employing longitudinal studies to discern the dynamic progressions of these relationships over time. Furthermore, expanding the research to include a broader range of diligence and cultural perspectives can provide a more comprehensive understanding of how these dynamics interact in diverse organizational settings. Future studies should also consider moderating constructs such as leadership style and organizational culture that can offer a profound understanding of the conditions under which digital platforms and AI adoption most effectively determine innovativeness.

Conclusions

This research underscores the pivotal role of digital platforms and AI adoption in driving organizational innovation, primarily through the mediating effects of e-knowledge and big data analytics capability. Furthermore, the results indicate that digital platforms and AI adoption are essential for boosting innovativeness; their effects are significantly strengthened by strategic flexibility, which enables enterprises to adapt and respond to new opportunities efficiently. This research recommends that institutions aiming to enhance their innovativeness should invest in the latest technologies and promote an adaptive and flexible strategic approach. By doing so, enterprises can fully exploit the advantages of advanced technological and AI tools, leading to sustained innovativeness and competitiveness in rapidly evolving environments. Additionally, this research encourages future studies to explore the dynamic interactions among knowledge management, technological adoption and strategic flexibility in fostering innovation from various organizational perspectives.

CRediT authorship contribution statement

Yi Lin: Writing – original draft, Validation, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Zahid Yousaf:** Writing – review & editing, Visualization, Supervision, Software, Methodology, Funding acquisition, Conceptualization. **Adriana Grigorescu:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Conceptualization. **Norina Popovici:** Writing – review & editing, Validation, Resources, Methodology, Investigation, Data curation.

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