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Leveraging digital human resource management to optimize organizational performance in Vietnam

Suong Huynh Thi Thu[1]✉, Minh Pham[2] & Hai-Nam Luc[1]

Although numerous studies have examined the effects of digital human resource management on organizational performance, the findings have been inconsistent due to the influence of contextual factors. It motivates continued exploration of whether businesses that utilize digital technology to manage people will boost their performance. Data were collected from 360 Vietnamese enterprises using digitalization in human resource management. The partial least squares structural equation modeling (PLS-SEM) was employed to test the path model. Based on research results, there exists a significant correlation between digital human resource management and organizational performance under a mechanism of mediating as well as moderating. Notably, the findings show that personnel strategy moderates the relationship between digital human resource management and employee performance ($\beta = -0.081$) at a significance level of 0.1. This result indicates that personnel strategy does not impact the relationship between digital human resource management and organizational performance. Additionally, the study proposes managerial implications regarding the role of digital human resource management in influencing employee engagement and performance as mediating, which emphasizes their participation toward efficiency. Furthermore, the research raises awareness of the importance of digital human resource management in the context of the greenization process and innovation to enhance performance and execution capabilities in an era based on the digitalization landscape.

[1] University of Finance - Marketing, Ho Chi Minh City, Viet Nam. [2] Ho Chi Minh City Open University, Ho Chi Minh City, Viet Nam.
✉email: huynhthusuong@ufm.edu.vn

Introduction

The digital economy has been gaining significant attention from researchers. Technology has been quietly infiltrating every aspect of all industries and fields, making the application of digital transformation in corporate governance an inevitable trend (Connelly et al., 2021; Fiaz and Qureshi, 2024; Trocin et al., 2021; Williams et al., 2023). Digital human resource management (D-HRM) has arisen and become a valuable tool in corporate governance due to its numerous benefits for D-HRM, such as reducing administrative costs, increasing processing speed, streamlining processes, and, most importantly, enhancing operational efficiency (Connelly et al., 2021; Malik et al., 2023; Trocin et al., 2021). Similarly, emerging digital technologies such as the Metaverse, extended reality (XR), and artificial intelligence (AI) are transforming business models by enabling more immersive collaboration, data-driven decision-making, and operational efficiency (Shahzad and Zhang, 2025). AI-powered digital employees, in particular, are playing an increasing role in enhancing operational efficiency and sustainability by automating tasks, improving customer experiences, and supporting business innovation (Wang and Zhang, 2025). These advancements in digitalization reinforce the strategic role of D-HRM in enhancing organizational flexibility and adaptability to changing business environments. Thus, D-HRM practices are rising (da Silva et al., 2022). Naturally, the implementation of D-HRM has been shown by numerous studies to enhance organizational performance through streamlined operational processes, increased flexibility, better employee engagement, and data-driven decision-making (Connelly et al., 2021; Halid et al., 2020; Jayabalan et al., 2021; Thite, 2022).

Nevertheless, researching and applying D-HRM remains challenging, as studies on its connection to organizational performance have been inconsistent (da Silva et al., 2022; Küpper et al., 2021). While some studies suggest that the impact of D-HRM on organizational performance is insignificant (Nicolás-Agustín et al., 2022; Ogbeibu et al., 2021; Vardarlier, 2020), others indicate a positive relationship between them (Halid et al., 2020; Jayabalan et al., 2021; Thite, 2022; Waldkirch et al., 2021), and some do not find a direct impact of D-HRM on the performance of the organization (Alomari, 2023). The discrepancies can be attributed to contextual aspects such as organizational size, human resources department involvement in the organization's strategic decision-making, competition in the international market, employee performance, and job satisfaction (Donnelly and Johns, 2021). These imply a research gap in the D-HRM regarding its limited application in developing countries, which has not been widely addressed (Nyathi and Kekwaletswe, 2023).

Developing countries adopt digital technologies superficially, implementing digital human resource management at a fundamental and rudimentary level (L'Écuyer and Raymond, 2023; Yadav et al., 2024). For instance, Nyathi and Kekwaletswe (2023) mention that African countries do not participate in the digital revolution in the same way as the developing world does due to a range of challenges, including inadequate skills, low levels of information technology adoption, and poor information technology infrastructure. Apart from the gaps mentioned above, the field of D-HRM still lacks a well-defined theoretical foundation and model, with previous researchers calling for more theoretical and empirical research (Trujillo-Gallego et al., 2022; Wan and Liu, 2021). This study conducts an empirical investigation of D-HRM's influence on organizational performance following the adaptive structuration and embeddedness theory (Zhou et al., 2021). Adaptive structuration theory (AST) addresses the interaction of information technology, social structures, and humans (DeSanctis and Poole, 1994). However, AST does not indicate how these factors interact (Zhou et al., 2021). Recent studies suggest integrating digital capabilities with sustainable practices significantly enhances organizational performance by aligning technology, operations, and culture (Xu et al., 2024). Therefore, this article proposes using embeddedness theory (ET) as a complementary perspective to make this study more comprehensive and detailed (Granovetter, 1985). Moreover, AST focuses on the interplay between technology and social structures in organizations, exploring how structures are modified through human interaction with technology. At the same time, ET emphasizes how economic actions are influenced by social relationships and networks, focusing on the broader social context and the embedded nature of financial behavior.

This study comprehensively analyzed the principal articles and addresses three purposes based on the theoretical gaps identified in previous studies. Firstly, this study seeks to investigate the impact of D-HRM on organizational performance (Ahmed, 2019) through the moderating mechanisms of personnel strategy (Zhou et al., 2021) and mediating of employee engagement and commitment (Alomari, 2023) and performance (Nyathi and Kekwaletswe, 2023). Secondly, this article intends to conduct an empirical investigation into the influence of D-HRM on organizational performance in developing countries to explore the impact of contextual factors. Furthermore, the AST and ET can be exploited to examine the interaction of critical factors concerning people, social structures, and information technology (DeSanctis and Poole, 1994). Specifically, it investigates the relationship between D-HRM adopters, digital human resources, and the social structures in which D-HRM is implemented, illustrating how they interact (Zhou et al., 2021).

Literature review

Adaptive structuration theory (AST). This theory, proposed by DeSanctis and Poole (1994), elucidates the interplay between advanced information technologies, social structures, and human interactions within D-HRM. This theory posits that the efficacy of technology is contingent not only upon the technology itself but also on the social structures in which it is implemented. Poole and DeSanctis (2004) emphasize the duality of structure, wherein individuals adapt to new technological structures and modify them to fit organizational contexts. Markus and Silver (2008) indicate that technology utilization can vary depending on member interaction patterns, their knowledge and experience with the technology, and the level of consensus regarding structure usage. AST provides a theoretical framework for understanding how advanced technologies interact with existing social structures, such as hierarchical reporting systems and standard operating procedures, to engender organizational change. Numerous scholars have applied AST to studying the implementations of enterprise resource planning systems (Rains and Bonito, 2017; Turner et al., 2019; Zhou et al., 2021), while Bondarouk et al. (2017) have employed this theory to explore the effect of electronic human resource management (E-HRM), demonstrating its expansion into the field of HRM.

Embeddedness theory (ET). ET, proposed by Granovetter (1985), posits that social relationships influence economic behavior. This theory comprises two main aspects: structural embeddedness and relational embeddedness (Zhou et al., 2021). Structural embeddedness refers to an actor's position within the overall network structure, while relational embeddedness pertains to the quality of actor dyadic exchanges (Gulati, 1998). Adopting ET's perception, almost all economic behaviors are "embedded" in networks of social relationships between individuals and D-HRM (Granovetter, 1985). Embeddedness theory helps

elucidate how social relationships affect the efficacy of advanced human resource management technologies. When the HR division has a high grade of structural embeddedness in strategic decision-making, it can better comprehend the organizational strategy and access valuable strategic information, enabling HRM digitalization actions to develop excellent strategic value (Zhou et al., 2021). Similarly, a high rank of relational embeddedness with business units allows the HR department to understand business operations better and provide more tailored optimization solutions (Amladi, 2017).

Organizational performance. Organizational performance (OP) and firm performance (FP) are two closely related concepts in management and organizational behavior research, with FP considered a subset of OP (Boehmer and Schinnenburg, 2023; Varadaraj and Al Wadi, 2021). In this study, the descriptions of OP are controversial and inefficiently unified in many kinds of organizations. Reasonably, OP is a concept that refers to the extent to which an organization achieves its objectives, encompassing three main domains: (a) financial performance (such as profitability, return on assets, and return on investment); (b) market performance (such as sales, market share, growth rate); and (c) operational performance (such as productivity, quality, production efficiency) (Daft and Armstrong, 2021; Lazazzara et al., 2020). In other words, OP measures the extent to which an organization achieves its ultimate objective (maximizing value for stakeholders) (Alshibly and Alzubi, 2022; Nyathi and Kekwaletswe, 2023). Similarly, Theotokas et al. (2024) conducted a more in-depth investigation into the components of organizational performance. They proposed that the concept of OP simultaneously encompasses five dimensions: financial performance, market performance, stakeholder satisfaction, internal process efficiency, and future adaptability and growth potential. Organizational performance is influenced by numerous internal factors such as organizational culture (Boehmer and Schinnenburg, 2023), technological infrastructure (Trocin et al., 2021; Williams et al., 2023), strategic orientation (El-Toukhy, 2021), as well as external factors including economic growth (Yanikkaya and Turan, 2020), legal regulations (Davidson et al., 2021) and competitive intensity (Malyarets et al., 2019). Recent studies have demonstrated that adopting e-HRM has positive impacts (Iqbal et al., 2018). Specifically, Zhou et al. (2021) identified technological, organizational, human, and social aspects as crucial elements for successful e-HRM undertaking. Similarly, findings from Ahmed (2019) and Nyathi and Kekwaletswe (2023) indicate that e-HRM enhances employee engagement and improves organizational outcomes. This aligns with the concept of structural duality proposed in AST (DeSanctis and Poole, 1994) and ET (Granovetter, 1985).

Digital Human Resource Management (D-HRM). D-HRM and electronic Human Resource Management (E-HRM) are closely interrelated concepts in modern human resource management. Although often used interchangeably, they exhibit notable distinctions. D-HRM guides the application of digital technologies and data analytics (Nyathi and Kekwaletswe, 2023), while E-HRM focuses on utilizing web-based technologies to support and automate human resource functions and processes (Malik et al., 2022). From a holistic perspective, D-HRM and E-HRM apply technology to human resource management to optimize organizational performance. Empirical research indicates that industrial internet adoption acts as a key enabler for digital transformation, significantly improving organizational performance and competitive advantage (Wang et al., 2024). Moreover, integrating immersive digital technologies such as AI, virtual reality (VR), and blockchain has enhanced decision-making, streamlined processes, and improved workforce agility, further reinforcing the value of digital transformation in HRM (Shahzad and Zhang, 2025). However, Zhou et al. (2022) elucidate the theoretical gap between these two concepts, positing that E-HRM is a crucial component of D-HRM, providing the technological foundation for collecting, storing, and managing personnel data, thereby facilitating data-driven analysis and decision-making. Al-Alawi et al. (2023) further suggested that D-HRM analytics can be employed to evaluate E-HRM effectiveness, implying that D-HRM can be viewed as an evolution of E-HRM, leveraging the power of data and analytics to inform strategic decisions and improve human resource management practices.

Additionally, Zhang and Chen (2024) argued that studying E-HRM and D-HRM in isolation may not yield optimal results in enhancing organizational productivity and efficiency. They proposed that a harmonious integration of these concepts would enable D-HRM to fully exploit the potential of technology and data, enhancing their competitive advantage and achieving sustainable success in the digital era. Given the close relationship between D-HRM and E-HRM, as discussed above, this study adopts a definition of D-HRM encompassing E-HRM, positing that combining these concepts can enhance research diversity. Moreover, Papademetriou et al. (2023) propose that D-HRM applies digital technologies and data analytics to improve efficiency, facilitate data-driven decision-making in HRM, and create a more intelligent work environment and personnel management system through technology adoption.

From another perspective, D-HRM is defined as the process of harnessing the potential of digital technologies for operational and strategic human resource management purposes, including the digitization of the work environment, human resource processes such as recruitment, training, and development, evaluation, as well as providing digital services to employees (Al-Kharabsheh et al., 2022; Strohmeier, 2020). Consequently, D-HRM is considered the next evolutionary step in applying information technology in HRM, aiming to comprehensively and strategically integrate digital technology through developing and implementing digital HR strategies (Al-Kharabsheh et al., 2022). According to AST, the effectiveness of D-HRM depends on its interaction with social structures within the organization, such as HRM systems (DeSanctis and Poole, 1994). Furthermore, ET suggests that when human resources are deeply involved in strategic decision-making processes and establish close relationships with other departments, the positive impact of D-HRM is maximized, leading to enhanced OP (Zhou et al., 2021). Based on these conceptualizations, it can be inferred that digital human resource management's influence on organizational performance largely depends on its integration with organizational structures and processes (Poole and DeSanctis, 2004). Recent empirical research further confirms that D-HRM significantly enhances digital transformation, which drives work productivity and innovative work behavior, thereby strengthening organizational performance (Zhang et al., 2024). Hence, the following hypothesis is proposed:

H1: Digital human resource management has a positive impact on organizational performance.

Employee Engagement (EE). EE is a positive psychological state of an individual at work, manifested through enthusiasm, dedication, and passion for work (Said and Umachandran, 2020). In other words, employee engagement represents employees' emotional, cognitive, and behavioral connections to their organization and its goals (Ruel, 2021). Numerous studies have highlighted the importance of employee engagement for organizational

performance and competitive advantage, as employee engagement is closely related to job satisfaction (Ahmed, 2019). Indeed, job satisfaction can be viewed as a factor that drives employee engagement (Ahmed et al., 2020; Malik et al., 2022; Sun and Bunchapattanasakda, 2019). Highly engaged employees typically demonstrate superior motivation, effort, and performance in their work, exhibit greater loyalty and commitment to the organization, and have lower intentions to leave the company (Ahmed, 2019; Malik et al., 2022; Nyathi and Kekwaletswe, 2023; Saks, 2019). Consequently, D-HRM with high employee engagement levels often achieves better outcomes, such as higher productivity (Malik et al., 2022; Wan and Liu, 2021), improved service quality, increased customer satisfaction, and enhanced profitability (Bansal et al., 2023).

Notably, Gallup (2017) found that enterprises with high employee engagement levels have 17% higher productivity, 24% lower turnover rates, and 21% higher profitability than enterprises with low employee engagement. Similarly, Gede and Huluka (2024) found that engaged employees significantly contribute to improved service quality and institutional effectiveness, reinforcing the positive link between engagement and performance. Conversely, low employee engagement is often associated with reduced motivation, poor performance, and high turnover rates (Meijerink et al., 2021; Panneerselvam and Balaraman, 2022; Sun and Bunchapattanasakda, 2019). Based on the above definition, adaptive structuration theory can be applied to examine the relationship between people and technology, people and social structures, and social structures and technology. Additionally, embedding theory can be used as a complementary perspective to understand better these relationships (Zhou et al., 2021). Implementing E-HRM helps automate HR processes, enhance communication, and facilitate information sharing, improving employee experiences and satisfaction (Zhang and Chen, 2024).

Akter et al. (2023) demonstrated that digital human resources management supports the development of trust-based relationships between employees and the organization by increasing transparency in human resources activities, promoting fairness and trust, and enhancing employee engagement (Ahmić and Ćosić, 2025). Paul and Singh (2023) also noted that D-HRM enables employees to access human resources information and services more conveniently and flexibly, empowering them to manage their work and personal development. Several empirical studies, such as Bresciani et al. (2021) and Paul and Singh (2023), have proven the positive impact of digital human resources management on employee engagement. Based on the arguments mentioned above, the following hypotheses can be proposed:

H2: Digital human resource management has a positive impact on employee engagement.

H3: Employee engagement has a positive impact on organizational performance.

Employee Performance (EP). EP is a core concept in HRM that refers to an individual's work outcomes and level of task accomplishment (Al-Kharabsheh et al., 2022). From another perspective, Mathis and Jackson (2019) define employee performance as employee fulfillment of predetermined quantitative and qualitative work standards. This concept also encompasses the total value contribution of specific behaviors employees perform within a given time frame (Lazazzara et al., 2020). Emphasizing the significance of employee performance, Zhou et al. (2021) assert that it represents the characteristics and value of work behavior to the organization.

Furthermore, employee performance is crucial for assessing individuals' capabilities, efforts, and work efficiency, thereby identifying their strengths and areas for improvement (Ahmed, 2019; Alomari, 2023). Aguinis (2023) also points out that employee performance is closely linked to a regular, fair, and constructive evaluation and feedback mechanism. Thus, enhancing employee performance is considered vitally important for the sustainable development of D-HRM, as it directly influences key indicators such as productivity, quality, customer satisfaction, and profitability (Zehir et al., 2020). Mardikaningsih (2024) further emphasizes that employee engagement and sustainable HRM practices contribute to organizational effectiveness by fostering a high-performance work culture and improving overall productivity. Zhang and Chen (2024) further confirm that digital transformation in HRM enhances employee efficiency and engagement, leading to improved overall performance. Hussain et al. (2023) argue that various factors influence employee performance, including individual competence, work motivation, work environment, and superior support. Personal competence, which encompasses the knowledge, skills, and attitudes necessary for job completion, is the primary foundation of employee performance (Halid et al., 2020). Recent studies further highlight that authentic leadership fosters autonomous motivation, enhancing employee creativity and engagement, thereby driving overall performance in digital work environments (Fateh et al., 2021).

Combined with the two theories of AST and ST, this reinforces the model of D-HRM's impact on organizational performance with employee performance as a mediator. Convincingly, AST highlights the interaction between cutting-edge technology, social structures, and human actions, wherein technology and organizational structures enable and shape each other through adaptation (DeSanctis and Poole, 1994). With AST, it can be observed that the application of digital technologies in human resource management creates new structures that facilitate employee performance development (Varadaraj and Al Wadi, 2021). Hamdan et al. (2024) highlight that digitalization in HRM enhances workflow efficiency and reduces bureaucratic delays, allowing employees to perform their tasks more effectively. This relationship is not linear. However, it is influenced by the interaction process between employees and the organization in flexibly adjusting D-HRM practices to align with the needs and culture of the enterprise.

Meanwhile, Granovetter (1985) posits that the economic behavior of individuals and D-HRM cannot be separated from the network of social relations and institutional structures in which it exists. Therefore, applying both theories in research on D-HRM explores the effectiveness of the HRM system depending on the quality of the technology and factors such as trust, cooperation, and information sharing among organizational members (Nyathi and Kekwaletswe, 2024). In other words, employee performance will be significantly improved if the implementation of E-HRM is accompanied by efforts to build a digital culture and foster exchange and mutual support among employees and departments (Nyathi and Kekwaletswe, 2023). Overall, both AST and ET suggest that the impact of D-HRM on OP through EP is the result of a complex interaction process between technology, people, and the organizational context. Based on the above arguments, H4 and H5 are stated:

H4: Digital human resource management has a positive impact on employee performance

H5: Employee performance positively impacts organizational effectiveness

Personnel Strategy (PS). Personnel strategy, defined as a pattern that emerges from a stream of essential decisions related to personnel management (Ghazy and Fedorova, 2022), is a comprehensive plan for managing and developing an organization's

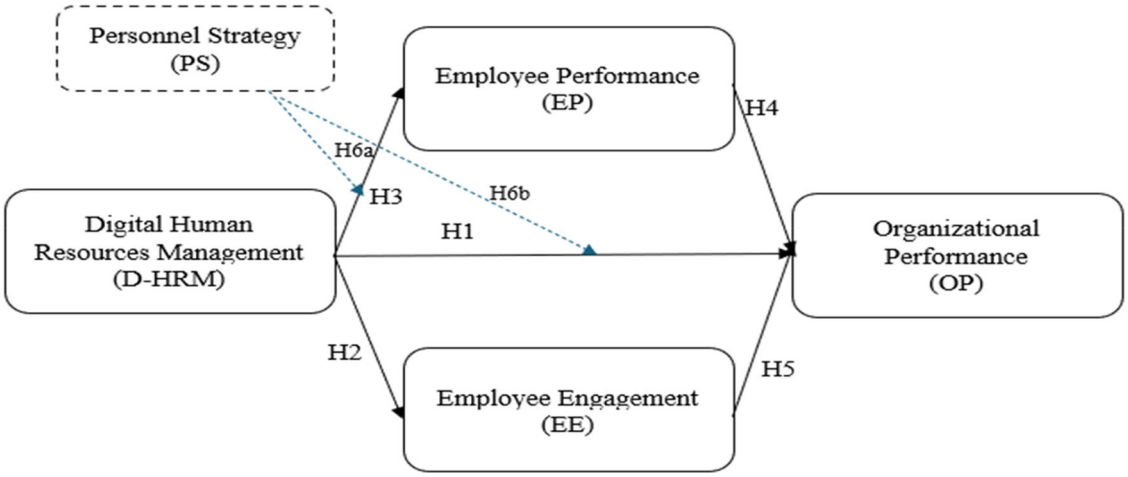

Fig. 1 Proposed theoretical model.

human resources to support the achievement of strategic objectives (El-Toukhy, 2021; Malik et al., 2023). In other words, personnel strategy represents a long-term orientation aligned with business strategy and ensures the most effective utilization of human resources (Vardarlier, 2020). Personnel strategy encompasses vital activities such as planning, recruiting, training, developing, evaluating, and retaining talent to build a competent, motivated, and engaged workforce to execute the strategy (Armstrong and Taylor, 2020; L'Écuyer and Raymond, 2023). Personnel strategy D-HRM proactively forecasts and meets human resource needs when effectively implemented, creating a sustainable competitive advantage (Panneerselvam and Balaraman, 2022). However, personnel strategy needs to be deployed consistently at both the strategic and operational levels, balancing people, work, and organizational context while being flexible to adapt to environmental changes and leveraging technology and data to enhance effectiveness (L'Écuyer and Raymond, 2023).

Vardarlier (2020) states that personnel strategy is an indispensable part of HRM, aiming to guide and optimize the management and development of human resources within an organization, including planning, recruiting, training, developing, evaluating, and retaining talent. This is equivalent to building a human resource system that is consistent and closely aligned with the long-term development orientation of the enterprise, including identifying HR needs based on business objectives, developing policies and programs to attract, develop, and retain high-performing employees, as well as creating a positive work environment that supports their personal and professional development (Vardarlier, 2020).

Throughout the research, AST suggests that the effectiveness of D-HRM depends on the relations of the adopters and the social structure in which D-HRM is applied (Poole and DeSanctis, 2004). ET is also used to support adaptive structuration theory, indicating that D-HRM, personnel strategy, employee engagement, and performance must interact to enhance organizational performance (Zhou et al., 2021). Furthermore, D-HRM can improve organizational performance through various factors, and more importantly, notification, the impact of D-HRM on organizational performance heavily depends on personnel strategy, as personnel strategy plays a crucial role in promoting and enhancing the effectiveness of D-HRM activities (Malik et al., 2023). As organizations' digital transformation drives the emergence of new approaches, models, and personnel requirements, personnel strategy must address these changes to guarantee that employees have the required qualifications and skills (Halid et al., 2020). Additionally, Wang and Zhang (2024a, b) suppose how digital adoption, digital drive, and digital culture operate as a system to bolster innovation performance, individual performance, and organizational-level outcomes in the digital era.

Naturally, D-HRM makes it possible to automate and optimize HR processes. Thus, the HR strategy must adapt to these changes and take responsibility for the proactive roles and strict requirements for personnel (Al-Kharabsheh et al., 2022). Therefore, having a suitable personnel strategy in digitalization conditions will help organizations effectively adapt to contemporary challenges and ensure their competitiveness.

The fundamental principles of the socio-humanistic approach can be applied to analyze an enterprise's performance, such as considering employees' individual needs and supporting their development and satisfaction from professional activities. This means that the efficiency and success of an organization are assessed not only by financial indicators but also by the level of satisfaction and development of its employees (Strohmeier, 2020). So, personnel strategy is one of the critical factors leading to the success of individual and organizational performance, helping to build a high-quality workforce and sustainable development in today's competitive era. Based on this, H6a and H6b are formulated as follows:

H6a: Personnel strategy moderates the relationship between digital human resource management and employee performance.

H6b: Personnel strategy moderates the relationship between digital human resource management and organizational performance.

From the logical arguments above, the proposed research model is as follows (Figs. 1 and 2):

Methods

Sample. The sample was selected using a stratified sampling technique to ensure the representativeness of the research population. The survey respondents were senior managers and human resource experts from Vietnamese D-HRM who utilize digital human resource management. Data was collected through 500 questionnaires sent out, with 360 responses received (a response rate of 74%). The collected data was processed using Smart PLS 4.1.0 software. Data were analyzed using the PLS-SEM method to test the research hypotheses. PLS-SEM is suitable for studies with complex relationships or small sample sizes (Hair et al., 2019). This is a considerable advantage of PLS-SEM compared to covariance-based structural equation modeling (CB-SEM) because CB-SEM requires a large sample size due to

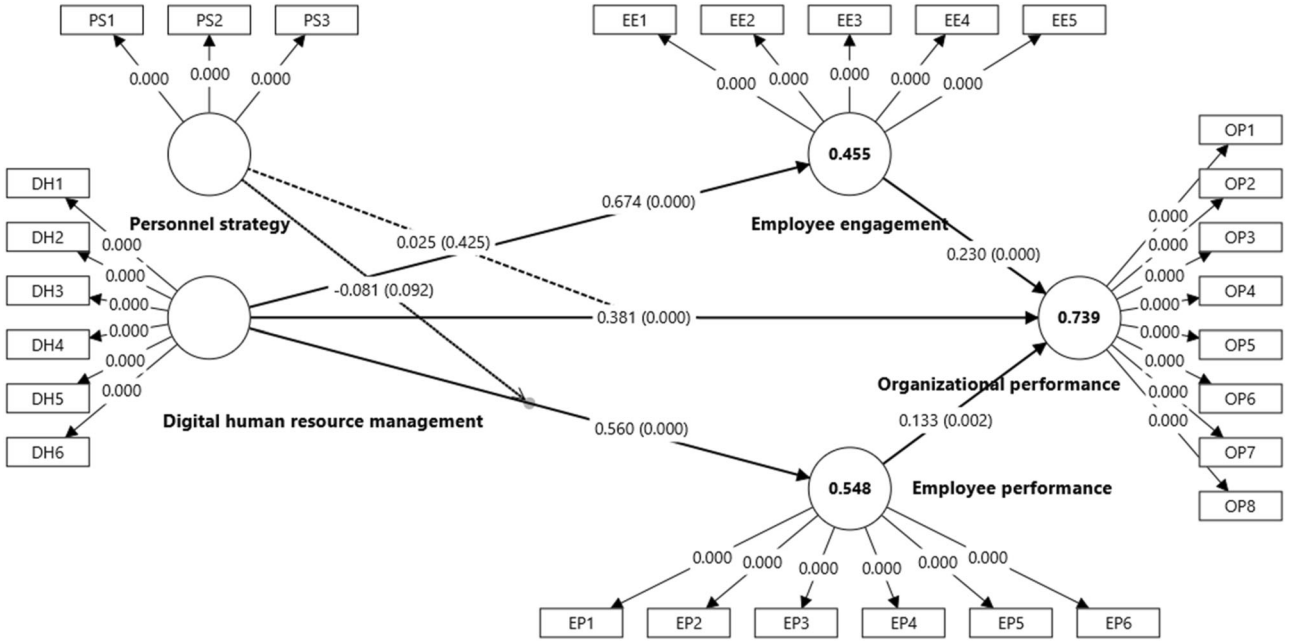

Fig. 2 PLS-SEM results.

Table 1 Data normality and convergent validity.

Variables	Item	Mean	SD	Kurtosis	Skewness	λ	α	CR	AVE
Digital Human Resources Management	DH1	3.069	0.893	0.098	0.262	0.845	0.902	0.925	0.673
	DH2	3.044	0.780	0.333	0.098	0.846			
	DH3	3.025	0.797	0.053	0.153	0.803			
	DH4	3.036	0.844	0.246	0.043	0.852			
	DH5	3.131	0.831	−0.436	−0.278	0.767			
	DH6	3.075	0.791	0.240	−0.100	0.804			
Organizational Performance	OP1	3.172	0.822	0.229	−0.389	0.887	0.936	0.947	0.693
	OP2	3.108	0.861	−0.228	−0.053	0.877			
	OP3	3.142	0.830	0.182	−0.124	0.822			
	OP4	3.114	0.870	−0.312	−0.070	0.846			
	OP5	3.000	0.853	−0.164	0.081	0.853			
	OP6	2.989	0.789	0.363	0.224	0.820			
	OP7	3.000	0.888	0.378	0.406	0.781			
	OP8	2.942	0.711	0.599	−0.242	0.764			
Employee Engagement	EE1	3.058	0.826	0.367	0.098	0.833	0.876	0.910	0.669
	EE2	3.047	0.870	−0.087	−0.066	0.854			
	EE3	3.006	0.833	0.256	0.047	0.821			
	EE4	3.078	0.840	−0.233	−0.091	0.755			
	EE5	3.111	0.767	0.385	0.142	0.824			
Employee Performance	EP1	3.081	0.735	−0.062	0.040	0.788	0.893	0.919	0.653
	EP2	3.081	0.814	0.628	0.347	0.776			
	EP3	3.044	0.906	−0.569	−0.133	0.795			
	EP4	3.042	0.886	−0.290	−0.130	0.833			
	EP5	3.025	0.870	0.087	−0.099	0.830			
	EP6	3.036	0.834	0.379	−0.010	0.823			
Personnel Strategy	PS1	3.094	0.728	0.645	0.417	0.823	0.796	0.880	0.710
	PS2	3.106	0.913	−0.061	−0.233	0.856			
	PS3	2.994	0.823	−0.203	0.070	0.849			

applying the maximum likelihood method. The relationships in this research model are pretty complex due to the testing of direct relationships and the assessment of moderating effects. In addition, with a sample size of only 360, applying the PLS-SEM method is suitable for the characteristics of this study.

The data in Table 1 contain descriptive statistics (mean, standard deviation, kurtosis, skewness) about the questions. The results also show that the data are in a normal distribution. In addition, among the 360 questionnaires returned, males accounted for 43% and females 57%. Most respondents had a university degree, accounting for 71.35%, 27.57% held master's degrees, and 1.08% had other qualifications. The 18–30 and 31–40 age groups represented similar proportions at 44.15% and 43.65%, respectively, while the 41–50 age group accounted for 11.1%, and the lowest representation was the 51–60 age group at 1.1%. All respondents were working in D-HRM that had already

implemented or planned to implement digital human resource management.

Measurement. All observed variables (items) were measured using a five-point Likert scale (1 = strongly disagree and 5 = strongly agree). Respondents were asked to indicate their level of agreement with the statements in the questionnaire. D-HRM was measured using six observed variables adapted from Alshibly and Alzubi (2022). OP was measured using eight observed variables adapted from the Nyathi and Kekwaletswe scale (2023). EP was measured using six observed variables adapted from the Nyathi and Kekwaletswe scale (2023). EE and PS were measured using five and three observed variables adjusted from the study of Shuck et al. (2017) and Ho et al. (2022), respectively.

Common method bias and multicollinearity. Testing for common method bias (CMB) is also essential. CMB occurs when variations in research data stem from the common measurement method rather than the intended variables, potentially distorting parameter estimates of relationships within a model. This bias can inflate or deflate the estimated relationship between two constructs (Antonakis, 2017). Kock (2017) proposed that an inner VIF value below 3.3 indicates that CMB does not significantly affect the analysis results. As shown in Table 3, the highest VIF value is 3.117, confirming compliance with this criterion. In addition, the outer VIF values ranging from 1.620 to 4.126 do not exceed the threshold of 5 (Hair et al., 2019). Therefore, multicollinearity does not strongly impact the results of evaluating the research hypotheses.

Results

Table 1 presents the reliability, convergent validity, and outer loading assessments for the scales used in the research model. The Cronbach's Alpha (α) for all scales is more significant than 0.7, ranging from 0.796 to 0.932, indicating good reliability of the measurement scales. Additionally, all outer loadings (λ) are above 0.7, demonstrating that the observed variables effectively measure their corresponding research constructs. Moreover, the average variance extracted (AVE) for all constructs exceeds 0.5, ranging from 0.627 to 0.710, and the composite reliability (CR) values are all greater than 0.7, ranging from 0.880 to 0.944, indicating that the scales meet the requirements for convergent validity. Thus, the results in Table 1 show that all measurement scales used in the study satisfy the criteria for reliability, convergent validity, and outer loadings (λ), providing a solid foundation for testing the research model and hypotheses.

Subsequently, Table 2 presents the HTMT (Heterotrait-Monotrait Ratio) matrix to consider the discriminant validity of the research model's constructs. According to Hair et al. (2019), an HTMT index of less than 0.9 meets the discriminant validity requirement. The results show that all values in the HTMT matrix are less than 1, ranging from 0.678 to 0.887, indicating that the research constructs achieve discriminant validity. This means that each construct measures a distinct content and does not overlap with other constructs in the model. This result ensures the unidimensionality of the measurement scales and the distinctiveness of the constructs, which is a necessary condition for further analyses, such as testing the relationships between the constructs in the research model.

Table 3 presents the results of hypothesis testing in the structural model. The results show that most of the hypothesized relationships are statistically significant at the 10% level (p-value = 0.1), except for the hypothesis about the moderating effect of personnel strategy on the relationship between D-HRM and organizational performance (p-value = 0.425 > 0.1). The path coefficients indicate that digital human resource management has a positive impact on organizational performance ($\beta = 0.383$), employee engagement ($\beta = 0.677$), and employee performance ($\beta = 0.562$). At the same time, employee engagement and employee performance also positively affect organizational performance, with coefficients of 0.227 and 0.134, respectively. These results support most research hypotheses, demonstrating the critical role of D-HRM and employee-related factors in enhancing organizational performance. Interestingly, this study showed that personnel strategy moderates the relationship between D-HRM and employee performance ($\beta = -0.081$) with a significance level of 0.1. However, the findings reject the moderating role of personnel strategy in the research context of Vietnamese D-HRM and organizational performance.

The determination coefficient (R^2) measures the ability of a concept to be explained by other concepts in the research model. Meanwhile, Q^2 examines the model's predictive ability. If it is positive, the model has predictive ability (Hair et al., 2019). The results in Table 4 show that the model has high explanatory power and predictive accuracy.

Table 5 analyzes the role of employee engagement and employee performance in the connection between D-HRM and organizational performance as mediators. The results show that employee engagement and performance have significant mediating effects in this relationship, with p-values of 0 (<0.01). Specifically, the indirect impact of D-HRM on organizational performance through employee engagement is 0.155, and employee performance is 0.074. These findings emphasize

Table 2 Heterotrait-monotrait ratio (HTMT) - Matrix.

	D-HRM	OP	EE	EP	PS
Digital Human Resources Management (D-HRM)					
Organizational Performance (OP)	0.864				
Employee Engagement (EE)	0.755	0.801			
Employee Performance (EP)	0.798	0.795	0.872		
Personnel Strategy (PS)	0.796	0.822	0.678	0.710	

Table 3 Hypothesis and CMB test.

Relationship	VIF	β	*P*-values	Result
D-HRM → Organizational Performance	2.695	0.381	0.000	Accepted
D-HRM → Employee Engagement	1.000	0.674	0.000	Accepted
D-HRM → Employee Performance	1.887	0.560	0.000	Accepted
Employee Engagement → Organizational Performance	2.699	0.230	0.000	Accepted
Employee Performance → Organizational Performance	3.117	0.133	0.002	Accepted
Personnel Strategy × D-HRM → Employee Performance	1.033	−0.081	0.092	Accepted
Personnel Strategy × D-HRM → Organizational Performance	1.047	0.025	0.425	Rejected

Table 4 Predictive relevance.

Constructs	Q^2	R^2
Employee Engagement (EE)	0.448	0.455
Employee Performance (EP)	0.533	0.548
Organizational Performance (OP)	0.677	0.739

Table 5 The results of indirect effects.

Relationship	β	P-values
D-HRM →Employee Engagement→ Organizational Performance	0.155	0.000
D-HRM →Employee Performance→ Organizational Performance	0.074	0.004

enhancing employee engagement and job performance as crucial mechanisms for D-HRM to improve organizational performance. This discovery provides empirical evidence supporting the theoretical view that directly and indirectly, D-HRM influences organizational effectiveness by improving employee engagement and performance.

Surprisingly, the findings reveal that the effect of D-HRM on EP decreases as personnel strategy intensifies. Moreover, the research results show that human resources strategy (PS) does not show a moderating role in the relationship between D-HRM and OP ($p = 0.425 > 0.05$). This differs from previous studies such as (Zhou et al., 2021), which is said to be the influence of the Vietnamese context, where the D-HRM application is still in its infancy and has not been closely integrated with the enterprise's personnel strategy. Theoretically, this result seems paradoxical and difficult to accept because, under the support mechanism of personnel strategy, previous studies showed that implementing D-HRM helps improve operational efficiency (OP) by optimizing operating processes, increasing flexibility, increasing employee engagement and making more scientific decisions based on (digital) data (Connelly et al., 2021; Halid et al., 2020; Jayabalan et al., 2021; Lumi, 2020; Thite, 2022; Varadaraj and Al Wadi, 2021). This consequence is mainly due to the current practical context in Vietnam, stemming from budget constraints to invest in digital infrastructure in forced digital transformation to optimize operational efficiency, including human resources. In addition, in the Vietnamese market, the proportion of micro, small, and medium enterprises (MSMEs) accounts for 94% (MPI, 2021), with the characteristics of MSMEs being concerned with short-term profits and flexible to changes in external and internal factors rather than shaping a long-term strategy. Thus, it robustly impacts managers' awareness of PS as a non-priority program.

Discussion

This article supplements existing knowledge by delivering an up-to-date outline and indicating variables, limitations, and research chances by selecting and analyzing the most well-known articles in D-HRM and OP research. Moreover, this study provides valuable insights into the relationship between D-HRM, employee engagement, and organizational performance. The study also elucidates the moderating role of personnel strategy in these relationships. Consequently, the research results reaffirm the vital role of D-HRM in improving the operational efficiency of businesses in Vietnam. This is consistent with many previous studies such as (Halid et al., 2020; Jayabalan et al., 2021; Nyathi and Kekwaletswe, 2023; Thite, 2022; Varadaraj and Al Wadi, 2021; Waldkirch et al., 2021).

Firstly, the study did not find a significant moderating impact of personnel strategy on D-HRM and organizational performance. This result contradicts AST, which suggests that the effectiveness of digital human resource management depends on its interaction with social structures within the organization, such as HRM systems. This finding implies that the impact of D-HRM on organizational performance may be more direct and less dependent on the alignment of personnel strategy. In Vietnam, implementing D-HRM by simply focusing on each employee in a personalized manner is enough to improve organizational performance. Secondly, the study confirms the positive impact of digital human resource management on organizational performance, employee engagement, and employee performance, as well as the positive influence of employee engagement and employee performance on organizational performance. These findings are consistent with previous research (Iqbal et al., 2018; Nyathi and Kekwaletswe, 2023) and provide empirical evidence supporting the application of AST (DeSanctis and Poole, 1994) and ST (Granovetter, 1985) in the context of D-HRM. The high R^2 values for organizational performance (0.739), employee performance (0.548), and employee engagement (0.455) indicate that the proposed model explains a significant proportion of the variance in these variables. This result suggests that D-HRM is an incredible driver for leveraging employee and organizational outcomes.

Notably, investing in digital HR practices can yield substantial benefits for D-HRM. The study highlights the mediating role of employee engagement and employee performance in the relationship between D-HRM and organizational performance. This finding aligns with the conceptualization of D-HRM as a tool to enhance employee experiences, engagement, and performance (Alomari, 2023; Nyathi and Kekwaletswe, 2023), promoting improved organizational outcomes. The results demonstrate that D-HRM not only directly impacts organizational performance but also indirectly influences it through its positive effects on employee engagement and performance. This emphasizes the importance of considering employee-related factors when implementing D-HRM initiatives and underscores the potential to create a more engaged and productive workforce.

Thus, the findings of this study align with the results of Iqbal et al. (2018), who emphasized the positive impact of D-HRM on organizational performance. However, this research further expands on these results by investigating mediators such as employee engagement and performance, offering a more comprehensive understanding of how D-HRM influences organizational outcomes. These discoveries are consistent with prior studies by Alomari (2023) and Nyathi and Kekwaletswe (2023). These studies highlight the significance of considering employee-related factors when evaluating the impact of D-HRM on organizational performance. The present study provides empirical evidence supporting this perspective and underscores the potential of D-HRM to foster employee engagement and performance.

Managerial implications. From a practical perspective, the study offers several implications for D-HRM seeking to leverage D-HRM to improve performance. First, D-HRM should prioritize implementing D-HRM practices, as they have been shown to positively impact employee engagement, employee performance, and organizational performance. This may involve investing in digital human resources tools and platforms, automating human resources processes, and providing employees with self-service options (Amladi, 2017; Strohmeier, 2020). Second, D-HRM should create a supportive and engaging work environment that fosters employee participation and enhances work efficiency

(Wang and Zhang, 2024a). This can be achieved through regular communication, feedback, and recognition, as well as providing opportunities for learning and development (Saks, 2006; Verčič and Vokić, 2017). By creating a positive employee experience, D-HRM can utilize the benefits of human resources and enhance organizational outcomes more efficiently. Finally, the study emphasizes the need for D-HRM to raise awareness about the importance of D-HRM in the context of digitalization, greenization, innovation, and sustainable development. In addition, employing several free digital tools for human resource management, such as SAP SuccessFactors, BambooHR, Zoho People, Kriyo, and OrangeHRM, which significantly enhanced performance for both individuals as well as organizations in Vietnam and other developing countries that support almost HR activities. It is widely used in organizations across developing nations for its scalability and comprehensive features.

As the business landscape evolves, D-HRM must adapt and leverage digital technologies to remain competitive and achieve sustainable success. By embracing D-HRM and fostering a culture of innovation and continuous improvement, D-HRM can enhance its performance and execution capabilities in the digital transformation era. Additionally, research has shown that leadership styles, particularly those that promote a learning-oriented culture, significantly impact organizational performance, with learning orientation mediating this relationship (Shahzad et al., 2024). For example, authentic leadership plays a vital role in this process, empowering employees, fostering trust, and encouraging creative problem-solving, which is essential for organizations navigating digital transformation (Fateh et al., 2021).

Limitations and future research. The research was carried out in all steps, including thorough theoretical and quantitative research. A key limitation in research on the impact of D-HRM on organizational performance in SMEs in Vietnam lies in the context-specific factors that may affect the generalizability of findings. Firstly, due to the relatively underdeveloped digital infrastructure in some regions, the level of technological adoption and integration varies significantly among SMEs, which can result in skewed results. Additionally, the research may be constrained by a limited sample size, mainly if the study focuses only on a few industries or geographical areas within Vietnam. Furthermore, there is often a lack of longitudinal data, making it difficult to assess the long-term effects of D-HRM systems on performance. Organizational culture and employee readiness for digital transformation can also serve as confounding variables that impact the outcome of HRM initiatives. Yet, these factors are not always fully accounted for in research. Finally, the rapid pace of technological advancement poses another challenge. D-HRM tools that are relevant today may quickly become outdated, thus complicating the evaluation of their sustained impact on organizational performance over time. As a result, the study has not fully considered other contextual factors that may affect the relationship between D-HRM and business performance.

Future research on the impact of D-HRM on organizational performance in SMEs in Vietnam should consider several key areas to provide a more comprehensive understanding of the relationship. Firstly, longitudinal studies are essential to capture the long-term effects of D-HRM adoption on performance metrics such as productivity, employee satisfaction, and retention. Additionally, future research should explore the role of organizational culture, employee digital literacy, and managerial support in successfully implementing D-HRM systems, as these factors can significantly influence the outcomes. A comparative study between SMEs in urban and rural regions of Vietnam could provide valuable insights into the regional disparities in digital HRM adoption and its impact. Furthermore, given the rapid technological advancements, researchers should investigate the evolving nature of D-HRM tools, their adaptability to different industries, and their integration with emerging technologies such as AI and data analytics. Finally, studies that examine the cost-benefit analysis of D-HRM adoption in SMEs, particularly in terms of return on investment and operational efficiency, would offer practical insights for business owners and policymakers aiming to leverage D-HRM for organizational growth and competitiveness.

Conclusion

This study examines the impact of Digital Human Resource Management (D-HRM) on Organizational Performance (OP), with a focus on the mediating roles of Employee Engagement (EE) and Employee Productivity (EP), as well as the moderating effect of Personnel Strategy (PS) in businesses in Vietnam. The findings reveal that D-HRM is positively associated with EE and EP and that EE and EP also exhibit a positive relationship with OP. Furthermore, EE and EP mediate the relationship between D-HRM and OP. However, the study finds that PS does not moderate this relationship as anticipated. From a practical standpoint, the results suggest that business leaders should prioritize D-HRM as a key factor that, directly and indirectly through EE and EP, enhances the operational efficiency of businesses in Vietnam.

This study offers valuable insights into the relationship between D-HRM, employee engagement, employee performance, and organizational performance within Vietnamese businesses. The findings demonstrate a positive impact of D-HRM on organizational performance, employee engagement, and employee performance, as well as a favorable influence of employee engagement and performance on organizational performance. These results are consistent with existing literature and reinforce the applicability of adaptive structuration theory and embeddedness theory in the D-HRM context. Furthermore, the study contributes to the growing body of knowledge on D-HRM by providing empirical evidence of its influence on organizational performance through employee engagement and performance. From a practical perspective, the findings offer actionable recommendations for businesses aiming to leverage D-HRM to enhance performance, including prioritizing D-HRM implementation, fostering a supportive work environment, and raising awareness of D-HRM's significance in the broader context of digitalization, sustainability, and innovation.

Additionally, as the business landscape evolves, D-HRM must adapt and leverage digital technologies to maintain competitiveness and achieve sustainable success. By embracing D-HRM and fostering a culture of innovation and continuous improvement, D-HRM can enhance its performance and execution capabilities in the digital transformation era. Future research could explore the role of different contextual factors in shaping the relationship between D-HRM and organizational performance or extend the scope to various countries and industries.

Data availability

No datasets were generated or analysed during the current study.

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Author contributions

Conceptualization, SH; methodology, NHL and SH; formal analysis, MP; investigation, NHL; validation, SH; visualization, MP; data curation, SH; supervision, SH; project administration, SH; writing—original draft preparation, NHL and SH; writing—review and editing, SH and MP.

Competing interests

The authors declare no competing interests.

Ethical approval

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki, and received ethical approval from the University of Finance - Marketing (UFM) ethics committee, with ethical approval reference number 393/HĐ-ĐHTCM, dated May 30, 2024. The UFM committee reviewed and approved the study protocol, involving research design and methods, participant eligibility criteria, data collection and privacy protection, and informed consent. All online questionnaires were obtained by considering the respondents' informed consent, and all respondents completed them voluntarily and anonymously.

Informed consent

The questionnaire used in this study was preceded by an informed consent statement in which respondents were provided with detailed information about the nature and purpose of the study, and were assured that the data would be used for academic purposes only. Participants were also assured that their responses would be kept anonymous and confidential. Participants were informed that there were no foreseeable risks associated with participating in the study and that they could discontinue their participation at any time without consequence. Participants confirmed that they voluntarily agreed to complete the survey by answering the questions in the online questionnaire during the period from July 2024 to September 2024.

Additional information

Correspondence and requests for materials should be addressed to Suong Huynh Thi Thu.