International Journal of Technology

http://ijtech.eng.ui.ac.id

Research Article

Impact of Digital Infrastructure on the Creative Innovation and Competitive Capacity of Small and Medium Enterprises in Vietnam

Lam Thanh Hien [1], Phan Thanh Tam [2,*]

[1]Rectorate Board, Lac Hong University, Dong Nai Province, 84, Vietnam
[2]Faculty of Postgraduate Studies, Lac Hong University, Dong Nai Province, 84, Vietnam
**Corresponding author: tampt@lhu.edu.vn; Tel.: +840908123911*

Abstract: Innovation is increasingly becoming a breakthrough and indispensable driving force in science and technology development, particularly in the country's development strategy, and is the key to improving competitiveness and businesses' rapid and sustainable development. Therefore, this study aimed to determine the impact of digital technology on creative innovation among small-scale enterprises in Vietnam. On this basis, the authors proposed policy implications that enhance creative innovation and competitive capacity. Qualitative methods were used to collect data and consult with 30 managers at 30 enterprises. The quantitative method was also applied by collecting survey data from 900 managers working for 900 small and medium enterprises in six large cities in Vietnam. Data were collected using an online questionnaire (docs.google.com) and processed using SPSS 20.0 software; Amos was based on the structural equation model. Research results show five factors affecting the creative innovation and competitive capacity of small and medium enterprises (SMEs) in Vietnam with a significance level of five percent: (1) financial resources (FR), (2) human resources (HR), (3) technology and digital infrastructure (TI), (4) corporate governance and innovation strategy (CG), and (5) policy and legal environment (PL). The authors also provided five policy recommendations for improving creative innovation and competitive capacity. Finally, the study concludes that innovation positively impacts the competitiveness of SME. Furthermore, the authors also point out that the relationship between innovation and technology and digital infrastructure is positive. The novelty of the research provides important policy implications for promoting innovation and improving competitiveness, focusing on improving technology and digital infrastructure.

Keywords: Competitiveness; Creative innovation; Digital infrastructure; Technology

1. Introduction

In the integration period, the highly competitive pressure, the potential risks of the current economy, and the continuous development of the 4.0 industrial revolution have caused businesses, especially those developing in the group model, to face many difficulties and challenges in finding and developing markets to better meet customer needs (Faeroevik and Maehle, 2022). Innovation is considered an essential factor to survive and grow in the ever-changing business environment, the key to creating competitive advantages and having a decisive influence on the company's long-term existence and development.

This work was supported by the 'Lac Hong University' funded by 'Grant Number: 171/QĐ ĐHLH'.

https://doi.org/10.14716/ijtech.v16i5.7638
Received February 2025; Revised March 2025; Accepted June 2025

With a dynamic and highly innovative environment, innovation also helps small and medium enterprises attract and retain talent, create a dynamic and creative working environment, and promote a culture of learning and creativity in the organization, which is very suitable for the needs of today's young generations (Rădulescu et al., 2023; Chatterjee et al., 2022). Therefore, innovation can be considered a key factor in helping small and medium enterprises enhance their competitiveness, expand their markets, and attract talent, thereby improving their competitive advantage and sustainable development (Azamela et al., 2022). Therefore, managers and researchers need to pay special attention to innovation to develop competitive advantages and increase business performance based on the development of the Industrial Revolution 4.0.

Innovation plays a significant role in enterprises' growth; however, innovation in Vietnamese enterprises is still limited. Vietnamese enterprises do not pay attention to innovation; innovation activities are mainly informal and passive minor improvements or modifications of existing ones. Therefore, innovation is a big problem for enterprises developing according to the group model because if innovation is not carried out evenly and uniformly throughout the group from the parent company to the subsidiary, it will lead to waste, causing significant losses that affect operations and finances (Zainuri et al., 2024; Park and McQuaid, 2023; Zhou et al., 2019). In response to this problem, this study explored the factors affecting innovation in organizations in enterprises developing according to the group model, thereby providing some management implications for enterprises to consider and establish orientations to improve innovation capacity.

Innovation is the implementation of a new or significantly improved product (goods/services) or process, a new marketing method. A new organizational measure in operational practice, work organization, or external relations. Innovation refers to the development of new products and services that improve and upgrade existing products and services to meet all customer needs (Neverauskienė et al., 2020). In this study, innovation is the process of a business implementing a new measure to improve the management apparatus, strategic thinking, and vision to help improve the company's productivity and efficiency, quickly adapt to changes in the business environment, and meet the requirements of the industrial revolution and the market economy.

Innovation is increasingly demonstrating its essential role and genuinely becoming a breakthrough driving force, indispensable in the development of science and technology and the national development strategy in general, the key to rapid and sustainable development. Innovation is an inevitable and irreversible trend and the typical development orientation of the world today. For Vietnam, this is an especially important factor contributing to promoting digital transformation, green transformation, and sustainable development in the new era of development.

Vietnam faces excellent opportunities but many difficulties and challenges in science, technology, and innovation. The biggest challenge is technological competitiveness compared with other countries in the region and the world. Vietnamese enterprises have not been able to fully master advanced technologies, especially in critical areas such as semiconductor chips, artificial intelligence (AI), cloud computing, etc…

In today's challenging business market, small and medium enterprises' application of innovation to enhance competitive advantages to maintain survival and development is a trend and a key to opening the door to innovation flexibility and creating outstanding development. Innovation plays a significant role in the development and survival of SME (Prakasa and Jumani, 2024). Innovation can help these enterprises create new products, services, and processes, even comprehensive innovation from organization to system and market, and that is the foundation for improving productivity, efficiency, and competitiveness (Andersen et al., 2022).

However, these studies frequently isolate these elements, employ small sample sizes, or concentrate on major firms in developed contexts. Few empirical studies have systematically incorporated these variables into a single model to analyze their impact on innovation and competitiveness, particularly among SMEs in emerging countries such as Vietnam. Furthermore, the importance of creative innovation in translating internal resources into competitive outcomes is underexplored. This study fills that gap by testing a comprehensive structural equation model

(SEM) that assesses how five key factors influence creative innovation (CI) and, consequently, competitive capacity (CC) in Vietnamese SMEs: financial resources (FR), human resources (HR), technology and digital infrastructure (TI), corporate governance and innovation strategy (CG), and policy and legal environment (PL). This study adds to the literature on innovation in EMs and provides practical insights for policy formulation and company strategy.

Innovation allows SMEs with limited resources to focus on areas where they can gain an advantage over larger competitors. This will enable them to more effectively focus their resources on unique products and services that meet customer needs. Furthermore, innovation provides opportunities to expand markets and find new customers. SMEs can reach new market segments by developing innovative products, services, or processes that increase revenue and profits. Hence, this study aimed to identify the determinants influencing creative innovation and competitive capacity and suggest policy recommendations for enhancing creative innovation and competitive capacity at small and medium enterprises in Vietnam. Creative innovation (CI) is now crucial to SMEs' long-term success in the face of fierce global competition and lightning-fast technological change. According to this study, financial resources (FR), human resources (HR), technology and digital infrastructure (TI), corporate governance and innovation strategy (CG), and the policy and legal environment (PL) are the five essential elements that impact innovation and CC. The innovative capacity of SMEs is shaped by each of these factors. Internal competencies, such as FR and HR, lay the groundwork for innovation investment and TDC.

TI boosts operational efficiency and digital transformation through its dual role as an innovation enabler and catalyst. CG provides strategic guidance and makes decision-making structures easier to back up innovative efforts. The laws, incentives, and regulations that constitute the external institutional framework of PL can positively or negatively impact innovation. Through creative innovation, this model establishes a causal relationship between internal resources, innovation, and market performance, which acts as a mediating variable. It transforms the influence of FR, HR, TI, CG, and PL into concrete competitive capacity advances. This study focuses on identifying five factors affecting the creative innovation and competitive capacity of small and medium enterprises in Vietnam, including (1) Financial resources (FR), (2) Human resources (HR), (3) Technology and digital infrastructure (TI), (4) Corporate governance and innovation strategy (CG), (5) Policy and legal environment (PL).

Financial resources play an essential role in promoting innovation and improving the competitiveness of SMEs. A business with stable capital efficiently invested in R&D applies new technology and improves production processes, thereby creating higher value products/services (Perez-Alaniz et al., 2022). In contrast, financial constraints make it difficult for businesses to implement innovation projects, affecting their competitiveness (Giebel and Kraft, 2019). Therefore, H1 and H2 propose the following Figure 1.

Human resources play an essential role in promoting innovation and improving the competitiveness of SME (Asriati et al., 2022; Lin et al., 2020; Bos-Nehles and Veenendaal, 2019). Personnel with suitable qualifications and skills help businesses easily apply new technology, improve processes, and develop innovative products (Islami and Mulolli, 2024; Harney et al., 2022). This improves quality and optimizes costs, creating a market competitive advantage. In addition, quality human resources help businesses increase their ability to adapt to change through creative thinking and problem-solving skills (Ghosh et al., 2021; Hong et al., 2019). Therefore, H3 and H4 propose the following Figure 1.

Technology and digital infrastructure play an essential role in promoting innovation and enhancing the competitiveness of SME (Valdez-Juárez et al., 2024; Lu and Shaharudin, 2024; Celestine, 2024). Modern technology helps businesses optimize production processes, improve product quality, and reduce operating costs (Harney and Alkhalaf, 2021; Hervas-Oliver et al., 2021). Digital platforms, such as artificial intelligence, big data, and cloud computing, help businesses make faster decisions and develop flexible business models (Gong et al., 2023). Therefore, H5 and H6 propose the following Figure 1.

Corporate governance and strategy play an important role in promoting innovation and enhancing the competitiveness of SME (Cheng et al., 2023; Yahaya and Nadarajah, 2023; Andersen et al., 2022). An effective management system helps businesses optimize resources, improve operational efficiency, and create favorable conditions for innovation initiatives (Kumar et al., 2023; Akpan et al., 2022). Thus, H7 and H8 propose the following Figure 1.

The policy and legal environment are essential in promoting innovation and enhancing the competitiveness of SME (Sabihaini et al., 2024; Tyler et al., 2023). Support policies, such as tax incentives, research grants, or innovation incentive programs, help businesses have more resources to develop technology and improve operational efficiency (Gao et al., 2023). Therefore, hypotheses H9 and H10 are presented in Figure 1.

2. Methods

Innovation plays an essential role in improving the competitiveness of SME (Sepúlveda and Collazos, 2023; Rumanti et al., 2022; Chege et al., 2020). Innovating products and services helps businesses create different values, meet market needs, and improve customer experience (Bodlaj and Čater, 2019). Therefore, H11 proposes the following in Figure 1.

H1: Financial resources (FR) affecting creative innovation (CI)
H2: Financial resources (FR) affecting competitive capacity (CC)
H3: Human resources (HR) affecting creative innovation (CI)
H4: Human resources (HR) affecting competitive capacity (CC)
H5: Technology and digital infrastructure (TI) affecting creative innovation
H6: Technology and digital infrastructure (TI) affecting competitive capacity (CC)
H7: Corporate governance and innovation strategy (CG) affecting creative innovation (CI)
H8: Corporate governance and innovation strategy (CG) affecting competitive capacity (CC)
H9: Policy and legal environment (PL) affecting creative innovation (CI)
H10: Policy and legal environment (PL) affecting competitive capacity (CC)
H11: Creative innovation (CI) affecting competitive capacity (CC)

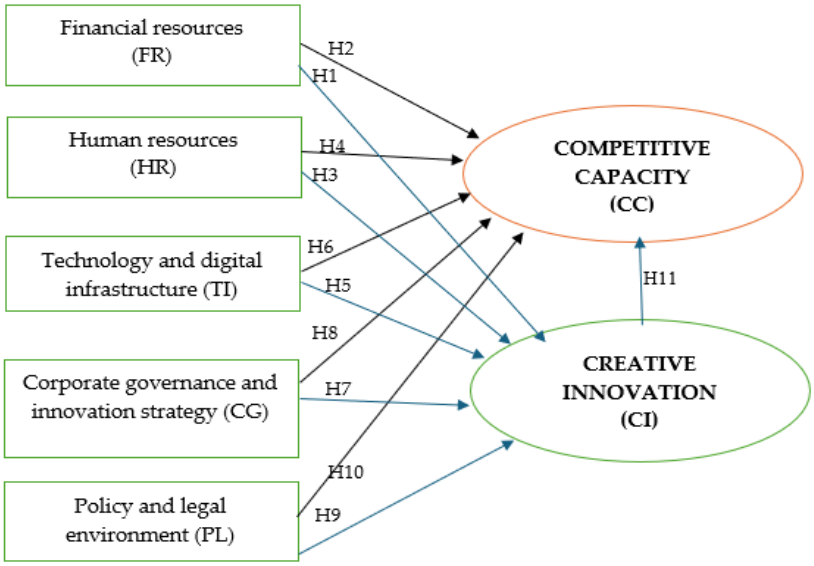

Figure 1 The model for critical factors affecting creative innovation and competitive capacity

Figure 1 shows five factors affecting the creative innovation and competitive capacity of small and medium enterprises in Vietnam: (1) financial resources (FR), (2) human resources (HR), (3) technology and digital infrastructure (TI), (4) corporate governance and innovation strategy (CG), and (5) policy and legal environment (PL).

The research process includes 3 stages: the qualitative, preliminary quantitative, and official quantitative stages.

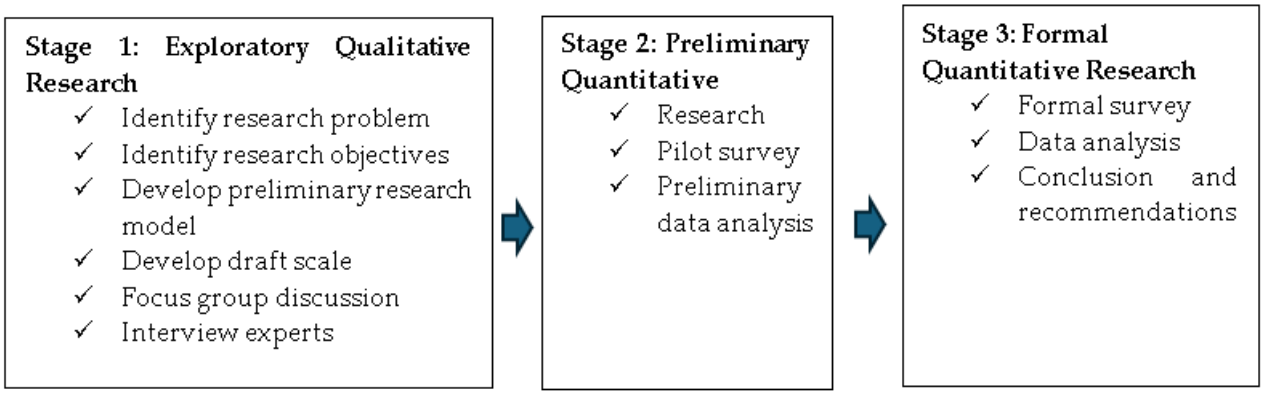

Figure 2 The research process for critical factors affecting creative innovation and competitive capacity

Phase 1: The authors design a research model for five factors affecting the creative innovation and competitive capacity of small and medium enterprises in Vietnam. This stage is performed through seven specific steps as follows:

Step 1: The problem that requires research based on five elements influencing the creative innovation and competitive capabilities of small and medium firms in Vietnam is determined. The writers investigated creative innovation and competitiveness issues based on their research into Vietnam's current state of small and medium businesses. In particular, the writers concentrated on essential topics with scientific and practical value to study factors impacting small and medium-sized Vietnamese firms' creative innovation and competitive capacity.

Step 2: The authors identify study objectives connected to five elements that impact creative innovation and competitive capacity. Once the topic that needs to be investigated has been identified, the research paper clearly states the general and specific research objectives.

Step 3: The authors provide a study model connected to five characteristics that impact the creative innovation and competitive capacity of small and medium enterprises in Vietnam. After establishing the research objectives, the authors reviewed prior studies on five characteristics that influence creative innovation and competitive capacity. After reviewing the research, the authors put out a research model.

Step 4: After developing a research model based on past surveys and research, the authors create a draft scale. They then produce a draft scale using scales as a foundation for using qualitative approaches to create scales. The qualitative result presented the straightforward questionnaire.

Step 5: The authors' research article discussion creates an outline for conducting group discussions to record the viewpoints of 30 managers. This is done by consulting relevant papers and previous studies. The discussions focus on five elements that affect Vietnamese small and medium firms' creative innovation and competitive capacity. The group discussion is intended to assess the initial scale and broaden it to better examine the study's components.

Step 7: The authors conducted expert interviews. The authors continued to interview 30 managers of 30 small and medium businesses using a questionnaire to evaluate the entire survey in general and the scale after it had been produced through group discussion in particular. Interviews are conducted with directors and managers of small and medium firms. Before the scale is used to gather data and conduct quantitative research, the findings from the expert interviews are meant to confirm the quality of the scale once again. At the end of this step, the authors finished the survey for theoretical research (Hair et al., 2018).

Phase 2: The authors conducted a preliminary study on five characteristics that influence creative innovation and competitive capacity. The authors conducted an initial study after deciding

on the research model and creating the survey scale. A preliminary survey was also conducted to guarantee that the scale developed was of high quality. The following specific steps are included in the initial research phase:

Step 8: An initial survey was conducted using a stratified probability sampling method. The authors surveyed 300 managers working at small and medium-sized businesses in Ho Chi Minh City.

Step 9: A preliminary inspection was performed. Cronbach's alpha coefficient was used to evaluate the scale based on acquired data. Once the reliability of the scale has been confirmed, it will enter the official research phase. Furthermore, in preliminary exploratory investigations, non-probability sampling is frequently employed to assess variables. The poll was conducted from November 2024 to January 2025, and the results have been processed. After testing the reliability of the scale and analyzing the factors, the authors employed a structural equation model (SEM) to assess the model and research hypotheses.

Phase 3: The authors conducted formal research involving an official survey, data analysis, conclusions, and managerial implications.

Step 10: The authors conducted a formal survey. The authors sent out survey questionnaires to 900 managers of small and medium businesses in six major cities in Vietnam: Can Tho City, Ho Chi Minh City, Da Nang City, Hai Phong City, Hue City, and Ha Noi City. To guarantee that the number of votes gathered fulfills the necessary number of observations for quantitative research, 900 ballots will be distributed. The poll was conducted by indirectly mailing questionnaires (online via docs.google.com) in six centrally managed large cities. The following are the degrees of agreement that were available in the study conducted by Hair et al. (2018): (1) I strongly disagree, (2) I disagree, (3) I am neutral, (4) I agree, and (5) I strongly agree. The sampling procedure was convenient and was given to each participant. However, out of the 835 samples tested, 65 votes were found to lack information. Consequently, the study model only used the remaining 835 votes.

Step 11: The authors analyzed the data: The primary survey data were loaded into the SPSS 20.0 program for descriptive statistics, and reliability coefficient tests using Cronbach's Alpha: Tests for Cronbach's Alpha reliability coefficient were conducted to assess the reliability of the measuring scales. This was essential in checking the internal coherence of the constructs and ensuring that the survey questions measured the correct theoretical variables. We identified items with low reliability and altered or eliminated them to increase the robustness of the measurement model; a threshold of 0.7 was considered acceptable for scale reliability. Examining the EFA: Exploratory factor analysis (EFA) was used to develop the measurement model by identifying key latent constructs and studying the observed variables' underlying structure. This was performed after the reliability evaluation. The suitability of the dataset for factor analysis was evaluated using Bartlett's test of sphericity and the KMO test. For retention purposes, we used eigenvalues higher than 1.0 and factor loadings higher than 0.5. The last collection of factors was considered to represent the investigated constructs well because of this procedure. The CFA will be carried out using the Amos software. The Amos program was used for CFA. Using CFA for construct validity assessment, convergent validity (the degree to which items within the same construct are connected) and discriminant validity (the degree to which constructs are dissimilar from one another) were evaluated. The effectiveness of the model was assessed using well-known goodness-of-fit metrics, including the comparative fit index (CFI) (>0.8), the Tucker-Lewis Index (TLI) (>0.9), the root mean square error of approximation (RMSEA) (0.08), and the chi-square/degree of freedom ratio (χ^2/df). The model fit and theoretical consistency were optimized by making necessary adjustments. Many prior studies relevant to this one used SEM. The conceptual framework's hypothesized links between variables were tested using SEM. Using the SEM, a robust multivariate analysis method, the authors investigated the interdependencies across variables by examining the direct and indirect impacts among the constructs. This methodology has gained widespread acceptance in empirical research because it can rigorously assess causal linkages while accounting for measurement mistakes.

Step 12: Conclusions were drawn, and the authors discussed managerial implications. The authors draw their judgments after analyzing the data. They guide managers concerning the innovative capacity and competitive possibilities of medium and small businesses. This study guarantees methodological rigor and strengthens the robustness of its findings by incorporating a multi-stage analytical methodology that includes descriptive statistics, reliability and validity testing, factor analysis, and structural equation modeling (SEM). The findings of this analytical procedure illuminate important theoretical frameworks and their practical consequences for the research topic.

3. Results and Discussion

The demographic structure and business features of Vietnamese SMEs were revealed by descriptive statistics such as mean, median, and mode to analyze the central tendency. The variance and standard deviation measure the data dispersion. Table 1 help understand the innovation, market competition, and external environmental factors of SMEs, laying the groundwork below.

Table 1 presents the descriptive data and Cronbach's alpha coefficients for the main characteristics that influence creative innovation and competitive capacity. The analysis investigates the internal consistency of the constructs and offers information on the mean values and standard deviations of individual items.

(1) Financial Resources (FR): The FR construct has excellent internal consistency ($\alpha = 0.960$), indicating high reliability. The mean scores for individual questions vary from 3.054 (FR1) to 3.119 (FR3), suggesting that respondents moderately agree on the availability and flexibility of FS for innovation. Notably, R&D budget stability (FR3, M = 3.119, SD = 0.963) is better established than other financial characteristics. However, the standard deviations show some variation in responses, especially for flexible financial policies (FR4, SD = 1.009), which could reflect different firms' financial strategies.

(2) Human Resources (HR): Cronbach's alpha for HR is 0.853, suggesting high dependability. HR2 has the highest mean score (M = 3.538, SD = 0.964), indicating that businesses prioritize training programs to improve employees' innovative skills. However, remuneration policies (HR3, M = 3.353, SD = 0.987) appear slightly less favorable, possibly reflecting gaps in incentive structures that promote innovation. The HR component indicates a positive assessment of the creative ability and enthusiasm of employees to participate in innovative activities.

(3) Technology, Digital Infrastructure (TI): With a Cronbach's alpha of 0.964, the TI aspect is highly reliable. The mean values for individual categories remain generally steady, with TI3 (M = 3.107, SD = 0.954) showing enterprise adoption of automation and digitalization. The relatively low mean for IT system infrastructure adequacy (TI2, M = 3.043, SD = 0.997) indicates that specific organizations may struggle to completely align their technology capabilities with innovation objectives. Given the significance of digital transformation in modern businesses, this study suggests a possible area for state intervention or investment.

(4) Corporate Governance and Innovation Strategy (CG): The CG construct ($\alpha = 0.955$) has good internal dependability. The mean values range from 3.030 (CG1) to 3.104 (CG3), indicating that firms strategically focus on innovation. The comparatively low score for leadership strategy (CG1, M = 3.030) suggests that not all organizations have well-defined innovation roadmaps. However, an innovation management system (CG3, M = 3.104) indicates that businesses are actively developing systems to evaluate and apply innovative ideas.

(5) PL: The PL has moderate reliability ($\alpha = 0.868$) and the lowest mean values across all components, ranging from 2.358 (PL1) to 2.501 (PL4). These findings suggest that government financial support for innovation is inadequate (PL1, M = 2.358, SD = 0.650). Legislative frameworks and administrative procedures (PL3, M = 2.398, SD = 0.652) impede innovation. The comparatively low scores across all criteria indicate that regulatory inefficiencies and a lack of accessible support mechanisms limit the innovation potential of enterprises.

Table 1 Testing descriptive statistics and Cronbach's alpha for critical factors affecting the creative innovation and competitive capacity

Code	Items	Cronbach's alpha	Mean	Std. Deviation
Financial resources (FR)		**0.960**	**3.076**	-
FR1	Enterprises have enough capital to invest in innovation activities.	0.942	3.054	0.992
FR2	Businesses can mobilize capital from many different sources to support innovation.	0.960	3.073	0.997
FR3	The enterprise's research and development (R&D) budget is maintained stable.	0.947	3.119	0.963
FR4	Enterprises have flexible financial policies to support the implementation of innovation projects	0.941	3.060	1.009
Human resources (HR)		**0.853**	**3.432**	-
HR1	Employees in the business have creative skills and innovative thinking	0.807	3.418	0.870
HR2	Enterprises regularly organize training programs to improve employees' innovation skills.	0.806	3.538	0.964
HR3	Enterprise remuneration policies encourage employees to participate in innovation.	0.836	3.353	0.987
HR4	Employees are highly motivated to contribute ideas for product/service innovation	0.804	3.418	0.912
Technology and digital infrastructure (TI)		**0.964**	**3.075**	-
TI1	Businesses invest significantly in technology to enhance innovation capabilities.	0.949	3.062	0.973
TI2	Enterprise information technology systems and infrastructure meet the need for innovation.	0.964	3.043	0.997
TI3	Enterprises apply automation and digitalization in production and operation processes.	0.948	3.107	0.954
TI4	The modern level of infrastructure has a positive impact on a business's ability to innovate	0.949	3.090	0.971
Corporate governance and innovation strategy (CG)		**0.955**	**3.066**	-
CG1	Business leaders have clear strategies for promoting innovation.	0.939	3.030	0.970
CG2	Corporate culture encourages employees to engage in innovation activities.	0.948	3.053	0.976
CG3	Businesses have an innovation management system to evaluate and implement new ideas.	0.936	3.104	0.934
CG4	Management decisions in businesses are made to support the development of innovation	0.939	3.075	0.971
Policy and legal environment (PL)		**0.868**	**2.426**	-
PL1	The government has financial support policies for innovative businesses.	0.837	2.358	0.650
PL2	The legal intellectual property protection system creates favorable conditions for businesses to innovate.	0.803	2.449	0.667
PL3	Legal regulations and administrative procedures do not hinder innovation activities.	0.846	2.398	0.652
PL4	Businesses can easily access innovation support programs from the state	0.838	2.501	0.734
Creative innovation (CI)		**0.957**	**3.402**	-
CI1	Enterprises regularly improve processes and products/services to meet market needs.	0.955	3.449	0.924
CI2	The business's products/services are clearly different from those of competitors.	0.917	3.388	0.942
CI3	Enterprises invest in technology and digital transformation in research and development (R&D) to promote innovation	0.936	3.370	0.954
Competitive capacity (CC)		**0.872**	**2.393**	-
CC1	The ability to maintain a business's competitive advantage	0.865	2.333	0.647
CC2	Enterprise innovation and creativity	0.808	2.425	0.668
CC3	Ability to optimize business costs	0.842	2.378	0.650
CC4	Ability to build brand and market share	0.825	2.437	0.711

(6) CI: CI has a Cronbach's alpha of 0.957, showing high internal consistency. The mean ratings vary from 3.370 (CI3) to 3.449 (CI1), indicating that businesses are aggressively improving procedures and investing in digital transformation. The comparatively low mean for CI3 (M = 3.370) suggests that, while firms realize the importance of technology in R&D, implementation issues may still exist. The high reliability and consistent mean scores indicate a firm's robust innovation culture.

(7) CC: The Cronbach's alpha for CC is 0.872, indicating strong internal consistency. However, this design has the lowest mean score, ranging from 2.333 (CC1) to 2.437 (CC4). Maintaining a competitive edge (CC1, M = 2.333, SD = 0.647) appears to be a significant difficulty for enterprises, most likely due to limited financial resources, regulatory backing, and digital infrastructure. The ability to build brand and market share (CC4, M = 2.437, SD = 0.711) has the highest mean within this category, demonstrating that firms view brand strength as a crucial competitive factor.

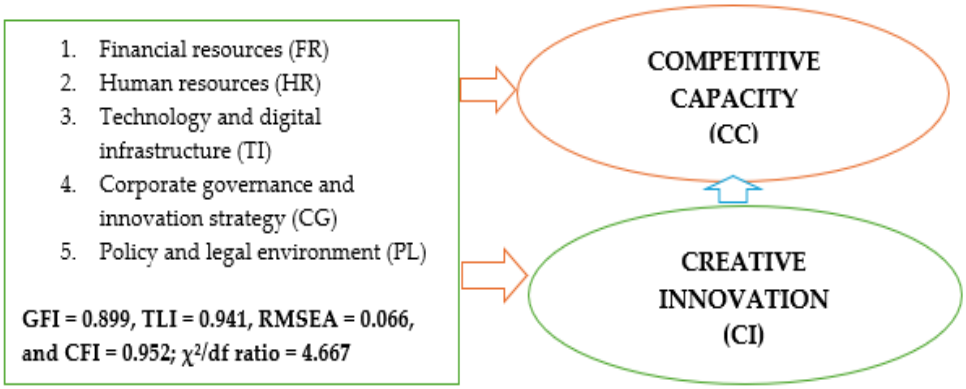

Figure 3 The confirmatory factor analysis for critical factors affecting creative innovation and competitive capacity

Figure 3 also evaluates the quality of the observed variables, confirming factor structures. CFA validates the measurement model by determining construct validity, reliability, and model fit indices. Model adequacy is confirmed by values of χ^2/df ratio (< 5.0), CFI (> 0.850), TLI (> 0.90), RMSEA (< 0.08), and SRMR (< 0.08). High factor loadings (> 0.70) guarantee convergent validity, whereas AVE (> 0.50) and CR (> 0.70) imply good construct reliability. The Fornell-Larcker criterion and HTMT ratio (<0.85) ensure discriminant validity.

Figure 4 shows the SEM results, which reveal causal links between significant factors that influence creative innovation and competitive capacity. The model fit indices ($\chi^2/df < 3.0$, CFI > 0.90, TLI > 0.90, RMSEA < 0.08) show good model adequacy. Financial resources ($\beta > 0.30$, $p < 0.05$), human resources ($\beta > 0.40$, $p < 0.01$), and technological infrastructure ($\beta > 0.35$, $p < 0.01$) have a beneficial impact on creativity. Corporate governance ($\beta > 0.25$, $p < 0.05$) promotes innovation, whereas policy and legal issues ($\beta < 0.20$, $p > 0.05$) have a more negligible impact. CI improves competitiveness ($\beta > 0.50$, $p < 0.01$) and influences resource allocation. Financial resources, human capital, technology, governance, and legislation have a substantial impact on creative innovation. Creative innovation mediates the relationship with competitive capacity. Businesses should maintain consistent R&D spending, invest in digital transformation, and promote an innovative culture. Policymakers should improve legal frameworks to encourage enterprise innovation. Effective corporate governance and incentive frameworks boost employee participation in innovation initiatives. Strengthening financial sustainability and improving technical skills increases competitiveness. The findings support a multifaceted innovation paradigm that informs corporate and policy actions.

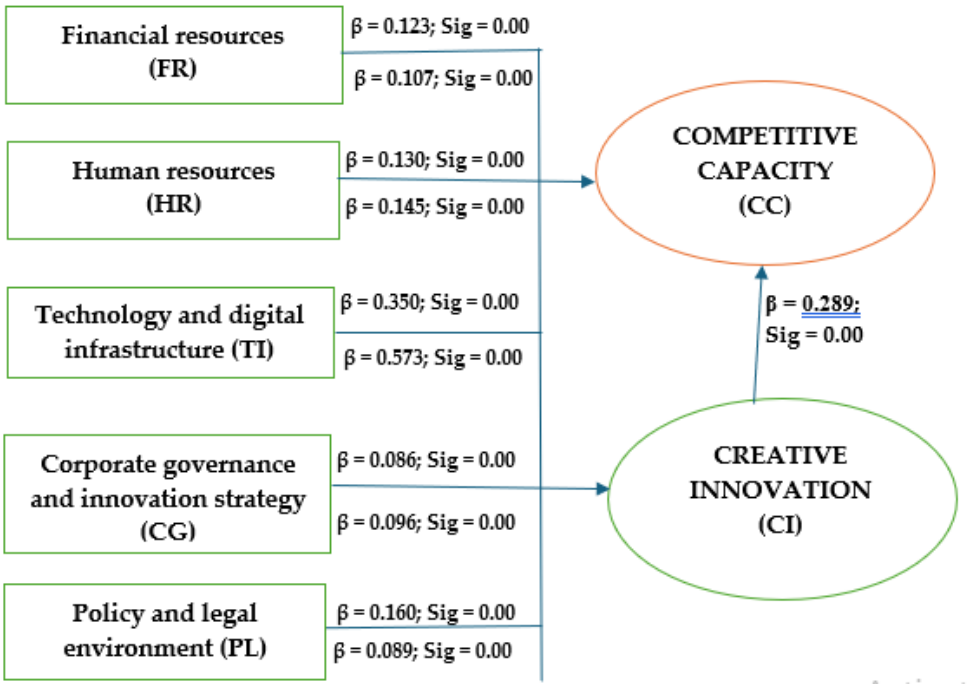

Figure 4 Testing critical factors affecting creative innovation and competitive capacity

Table 2 shows the five characteristics that influence creative innovation and competitiveness in Vietnam's small and medium-sized firms. These variables are statistically significant at a p-value of 0.05. The main contribution of this article is identifying the technology and digital infrastructure (TI) that significantly impact the creative innovation and competitiveness of Vietnam's small and medium-sized firms. This influence is measured using a standard estimate of 0.573. This is the most influential aspect and priority for policy execution, with significant repercussions.

Table 2 Testing critical factors affecting the creative innovation and competitive capacity

Relationships			Standardized estimate	S.E	C.R	P	Result
HR	→	CI	0.145	0.031	4.581	***	Accepted H3
PL	→	CI	0.089	0.054	3.055	0.002	Accepted H9
TI	→	CI	0.573	0.028	18.765	***	Accepted H5
CG	→	CI	0.096	0.023	3.399	***	Accepted H7
FR	→	CI	0.107	0.024	3.745	***	Accepted H1
CI	→	CC	0.289	0.028	7.330	***	Accepted H11
FR	→	CC	0.123	0.018	4.098	***	Accepted H2
CG	→	CC	0.086	0.017	2.985	0.003	Accepted H8
TI	→	CC	0.350	0.025	9.192	***	Accepted H6
PL	→	CC	0.160	0.041	5.174	***	Accepted H10
HR	→	CC	0.130	0.022	3.986	***	Accepted H4

*Note: *** is significance 0.01*

Table 2 shows the SEM results, which indicate the essential correlations between resources, innovation, and competitiveness. Technology infrastructure ($\beta = 0.573$, $p < 0.001$) is the most potent driver of CI, followed by human resources ($\beta = 0.145$, $p < 0.001$) and financial resources ($\beta = 0.107$, $p < 0.001$). Corporate governance ($\beta = 0.096$, $p < 0.001$) and policy and legal environment ($\beta = 0.089$, $p = 0.002$) have a lower impact on innovation. CI improves competitive capacity (CC) ($\beta = 0.289$, p

< 0.001), moderating the effect of resources on competitiveness. Technology (β = 0.350, p < 0.001) was the most significant predictor of CC, followed by policy (β = 0.160, p < 0.001) and financial resources (β = 0.123, p < 0.001). Corporate governance (β = 0.086, p = 0.003) has a minimal direct impact on CC. To maintain innovation and competitiveness, firms must prioritize digital transformation, financial stability, and skilled talent. Policymakers should improve regulatory frameworks and support innovation. Effective corporate governance and leadership can boost innovation strategy. These findings emphasize the essential role of innovation in creating competitive advantages.

Based on model testing, the authors proposed the following policy recommendations:

(1) Prioritize technology and digital infrastructure: Businesses should invest in digital transformation, automation, and information technology (IT) infrastructure to boost creative innovation and market competitiveness. Business administrators must ensure consistency in building and proposing short-, medium-, and long-term strategies to synchronize strategic management from the group level to member companies, providing operations with each group member's goals, quality, and efficiency. Self-assessment of the current state of technology, strengths, and weaknesses in the organization, thereby adjusting strategies, improving infrastructure and materials, and raising awareness of the opportunities and benefits of innovation, is required.

(2) Investing in financial and human resources by providing solid financial resources and competent labor will be critical in supporting long-term innovation initiatives and building creative talents in the workforce. Leaders must be determined to change their thinking and clearly define goals prioritizing innovation. Employees should be encouraged to continuously learn and develop skills so that they can innovate and adapt to changes in the business environment. They should also be willing to listen, collaborate, and communicate effectively between different departments and work groups within the organization to promote the sharing of ideas and information, creating opportunities for innovation and creativity.

(3) Corporate governance should be strengthened by linking corporate governance strategy with innovation aims to ensure that leadership and decision-making promote an innovative culture. Business administrators need to invest in fostering and developing the business's workforce to increase professionalism and efficiency, regularly organizing courses and training internally or in association with training units outside the company to enhance employees' ability to learn, update new knowledge, and develop practical skills with the goal of innovation, improving the quality of material resources and human knowledge resources to continuously absorb, create, and transform new technologies. Knowledge of new products and services provided to the market.

(4) Refine regulatory frameworks, provide financial assistance, remove bureaucratic impediments, and allow enterprises to innovate without being overly constrained to improve policy support. To make it easier for SMEs to access credit capital sources, a harmony of interests of three factors: credit institutions, businesses, and state mechanisms and policies, must be established. Banks must innovate credit mechanisms and policies according to market principles and more straightforwardly improve lending procedures for SMEs to shorten loan approval time. In addition, SMEs need to make the accounting book system transparent and standard to make it convenient for banks to monitor production and business activities, thereby quickly making loan decisions.

(5) Firms should integrate innovation-driven initiatives into their fundamental business models to stimulate continual development and preserve a long-term competitive advantage in the market. Business administrators should create a culture that is open to innovation and willing to accept business changes and challenges. Create interactions between firms in the same ecosystem to promote the exchange of ideas, coordination, and cooperation among employees, thereby enhancing the ability to learn more within the business and contribute to innovation.

Some countries have successfully deployed many policy tools to strengthen business capacity and promote innovation activities, and this result has also had the impact of promoting technology reception and absorption. On the one hand, the government encourages small and medium enterprises to upgrade their technology by building their absorptive capacity and providing

information and knowledge on how to apply new technologies. On the other hand, the government also focuses on promoting the transfer and commercialization of new technologies from universities and public research organizations.

Table 3 displays the construct reliability (CR), average variance extracted (AVE), and maximum shared variance (MSV) of the critical components that influence creative innovation (CI) and competitive capacity. The results show that all conceptions meet the validity and reliability standards, indicating that the measures are robust.

(1) Construct reliability (CR) and convergent validity: CR scores surpass 0.80 for all constructs, indicating high internal consistency and reliability. AVE values exceed 0.50, indicating that each factor accounts for more than half of its variation, indicating good convergent validity. Technology Infrastructure (TI = 0.872) and Creative Innovation (CI = 0.860) have the highest AVE, indicating that their assessment items accurately identify these entities.

(2) Maximum shared variance (MSV) and discriminant validity: MSV values remain below AVE for all constructs, indicating discriminant validity, meaning each concept is unique. Technology infrastructure (MSV = 0.387) and creative innovation (MSV = 0.387) have the most significant variance, indicating a strong link between digital infrastructure and innovation capacity. Competitive Capacity (MSV = 0.286) exhibits moderate shared variance, indicating a strong link to innovation and technical investment.

(3) Key results and implications: TI and CI have the highest construct validity, highlighting the importance of DT in fostering innovation and competitiveness. Financial resources (FR) and human resources (HR) exhibit high reliability (CR > 0.80) but lower MSV, implying that, while important, they may indirectly drive innovation via other factors. Corporate governance and innovation strategy (CG) have the lowest MSV (0.021), indicating a more independent impact on innovation than financial and technological elements. Finally, the AVE and CR results validate the robustness of the measurement model, ensuring convergent and discriminant validity. The close relationship between technology, innovation, and competitive capacity emphasizes the importance of digital investments, governance initiatives, and financial sustainability in enabling innovation-driven growth.

Table 3 Extracted testing average variance for factors affecting creative innovation and competitive capacity

Indicators	CR	AVE	MSV	Results
HR	0.825	0.549	0.052	Good
TI	0.965	0.872	0.387	Good
FR	0.950	0.826	0.052	Good
CG	0.952	0.833	0.021	Good
CC	0.872	0.634	0.286	Good
PL	0.867	0.630	0.046	Good
CI	0.949	0.860	0.387	Good

Table 4 shows the bootstrap results based on 80.000 resampling iterations, which ensure robust estimation of standard errors (SE), biases, and confidence ratios (CR) for the relationships between human resources (HR), financial resources (FR), technology infrastructure (TI), CG and innovation strategy (CG), PL, CI, and CC.

(1) Robustness of parameter estimation: The SE values are consistently low (≤ 0.083) across all connections, indicating that the estimates are solid with minimal variability. The SE-SE values are close to zero, supporting the standard error estimates' constancy. Bias values are modest (< 0.01) across all associations, indicating that bootstrap resampling does not cause significant departures from initial estimates.

(2) Path coefficients and significance: Technology and digital infrastructure (TI → CI, Mean =

0.527, SE = 0.042, CR = 1.00) have the most significant impact on creative innovation, highlighting the importance of digital transformation in encouraging creativity. Creative innovation (CI → CC, Mean = 0.209, SE = 0.030, CR = 1.33) is still the most significant indicator of CC, highlighting its mediating role. Financial resources (FR → CI, mean = 0.085, SE = 0.025, CR = 1.50) and human resources (HR → CI, mean = 0.138, SE = 0.041, CR = 1.50) have moderate influences, demonstrating that capital investment and workforce capabilities are substantial but secondary to technology adoption. CG (CG → CI, mean = 0.071, SE = 0.026, CR = 1.60) and PL (PL → CI, mean = 0.153, SE = 0.083, CR = 1.33) had weaker effects, indicating that while governance and regulatory factors promote innovation, their impact is indirect.

(3) Direct and indirect effects on CCTI (TI → CC, Mean = 0.223, SE = 0.024, CR = 1.20) improve competitiveness, supporting the notion that DT is a critical driver of corporate performance. Financial resources (FR → CC, mean = 0.068, SE = 0.021, CR = 1.25) and human resources (HR → CC, mean = 0.084, SE = 0.024, CR = 1.25) have a moderate impact on competitive capability, indicating the need for steady financial backing and skilled workforce. Corporate governance (CG → CC, Mean = 0.050, SE = 0.026, CR = 1.00) has the least direct effect but plays an indirect contribution through innovative methods.

(4) Impact on business and policy: Technology and digital infrastructure should be prioritized to improve innovation and competitive posture. Investment in financial and human capital remains crucial for fostering long-term ecosystems of innovation. Regulatory rules should be improved to encourage innovation-driven company practices. Corporate governance should coincide with innovation policy to gain a competitive advantage. Finally, the bootstrap results support the reliability of the SEM estimations, highlighting the importance of technology, financial resources, and innovation initiatives in defining competitive capability. These results highlight the significance of innovation-driven business strategies for long-term viability.

Table 4 Testing Bootstrap 80.000 samples for factors affecting the creative innovation and competitive capacity

Parameter	SE	SE-SE	Mean	Bias	SE-Bias	CR	Results
HR → CI	0.041	0.001	0.138	0.003	0.002	1.50	Good
PL → CI	0.083	0.002	0.153	0.004	0.003	1.33	Good
TI → CI	0.042	0.001	0.527	0.001	0.001	1.00	Good
CG → CI	0.026	0.001	0.071	0.008	0.005	1.60	Good
FR → CI	0.025	0.001	0.085	0.003	0.002	1.50	Good
CI → CC	0.030	0.001	0.209	0.004	0.003	1.33	Good
FR → CC	0.021	0.000	0.068	0.005	0.004	1.25	Good
CG → CC	0.026	0.001	0.050	0.001	0.001	1.00	Good
TI → CC	0.024	0.001	0.223	0.006	0.005	1.20	Good
PL → CC	0.076	0.002	0.193	0.009	0.006	1.50	Good
HR → CC	0.024	0.001	0.084	0.005	0.004	1.25	Good

4. Discussion of the findings

Based on SEM testing, the findings identify five key factors that affect creative innovation and competitive capacity at SME, with a sig. 0.05. The structural path coefficients from the SEM model, which assesses the relationships between financial resources (FR), human resources (HR), technology and digital infrastructure (TI), corporate governance and innovation strategy (CG), policy and legal environment (PL), creative innovation (CI), and competitive capacity (CC), were obtained. The authors have synchronously implemented the following discussions:

(1) Model validation and significance: All hypotheses (H1-H11) were accepted, and critical ratios (CRs) exceeded 1.96, indicating statistical significance ($p < 0.05$) (Ueasangkomsate, 2025; Bolsunovskaya et al., 2023; Fang et al., 2022). The strong route coefficients validate the conceptual

framework, stressing the interaction of resource allocation, innovation, and competitiveness. Financial resources play a key role in supporting innovation in SMEs in Vietnam. The study found that enterprises that can maintain a stable R&D budget will have favorable conditions to innovate products and production processes. However, the average level of consensus among enterprises reflects the fact that many barriers exist in accessing flexible capital, especially from financial institutions. Therefore, increasing financial support and improving credit policies are necessary to open up capital flows for innovation projects.

(2) Key drivers of creative innovation (CI): Technology infrastructure (TI → CI, $\beta = 0.573$, $p < 0.001$) has the most significant impact, emphasizing the importance of digital transformation in driving innovation. Financial resources (FR → CI, $\beta = 0.107$, $p < 0.001$) and human resources (HR → CI, $\beta = 0.145$, $p < 0.001$) have a considerable impact on innovation, highlighting the need for consistent funding and talented personnel (Valdez-Juárez et al., 2024; Celestine, 2024; Sepúlveda and Collazos, 2023; Maarouf and Korableva, 2022). Technology and digital infrastructure have the strongest influence on innovation and competitiveness. The application of AI, big data, cloud computing, and automation helps businesses optimize processes and improve efficiency. However, some businesses still face difficulties in fully investing in IT infrastructure. This shows the need for specific support policies to promote digital transformation, helping SMEs increase their ability to innovate and compete more effectively in the context of the 4.0 industrial revolution.

(3) CG (CG → CI, $\beta = 0.096$, $p < 0.001$) and PL (PL → CI, $\beta = 0.089$, $p = 0.002$) have a lesser impact on innovation (Nga, 2024; Sepúlveda and Collazos, 2023; Yashin et al., 2023; Naruetharadhol et al., 2022). This suggests that while strategic leadership and regulatory support facilitate innovation, their direct influence is weaker than that of technology and financial investments. Corporate governance supports innovation by building management systems and cultures that encourage innovation. Businesses tend to invest in systems to evaluate and implement new ideas. However, leadership strategies are unclear and inconsistent across management levels, reducing innovation effectiveness. Therefore, establishing the central role of leadership and integrating innovation strategies into the business's overall development orientation is a necessary direction.

(4) Determinants of CC: Creative innovation (CI → CC, $\beta = 0.289$, $p < 0.001$) enhances competitiveness by moderating the effect of innovation on resources and competitive advantage (Albugami and Zaheer, 2023; Aliasghar et al., 2023; Ivashchenko et al., 2021). Technology infrastructure (TI → CC, $\beta = 0.350$, $p < 0.001$) is still a significant predictor of competitive success, highlighting the need for advanced digital capabilities. Financial resources (FR → CC, $\beta = 0.123$, $p < 0.001$) and human resources (HR → CC, $\beta = 0.130$, $p < 0.001$) positively impact competitiveness, demonstrating that financial stability and skilled labor improve the market positioning of enterprises. Human resources are considered the most important factor influencing SMEs' innovation. Enterprises regularly organize training courses and encourage employees to contribute innovative ideas. However, the remuneration policy has not really promoted employees' deep participation in the innovation process. Improving motivation and creating clear recognition and reward mechanisms are necessary to maximize internal creative potential, thereby increasing enterprises' adaptability and innovation.

(5) The policy and legal environment (PL → CC, $\beta = 0.160$, $p < 0.001$) has a moderate impact, indicating that a firm's competitive advantage is maintained by favorable regulatory frameworks. While CG (CG → CC, $\beta = 0.086$, $p = 0.003$) is statistically significant, it has the least impact on competitiveness (Nhat, 2025; Ndiinee and Gever, 2025; Aliasghar et al., 2023). This suggests that while governance encourages strategic innovation, its direct effect is weaker. Policy and legal environment are considered the weakest factors in supporting SMEs' innovation. Enterprises reflect that administrative procedures are still cumbersome, financial support policies are ineffective, and IPP mechanisms are unclear. These are the major barriers to innovation. The study recommends institutional reform, process simplification, and increased transparency to facilitate SMEs to innovate more smoothly and sustainably.

This study has several outstanding new points. First, the research process was systematically

implemented through three stages, namely, qualitative, preliminary quantitative, and formal quantitative, 12 steps, to increase the reliability of the results. Second, survey data were collected from 900 managers in six major cities in Vietnam, ensuring high representativeness. Third, the study applies SEM, CFA, and Bootstrap analysis with appropriate indicators to improve scientificity and accuracy. Fourth, the mediating role of 'innovation' in the relationship between resources and competitiveness is highlighted, something that has rarely been mentioned in previous studies. Finally, specific and feasible policy recommendations are proposed, providing a basis for managers and policy makers.

5. Conclusions

Survey data were collected from 900 managers working for 900 small and medium enterprises in six big cities in Vietnam, including Can Tho City, Ho Chi Minh City, Da Nang City, Hai Phong City, Hue City, and Ha Noi City. A review of the critical factors influencing creative innovation (CI) and competitive capacity (CC) revealed numerous key findings. Moreover, TI has a significant impact on both CI ($\beta = 0.573$, $p < 0.001$) and CC ($\beta = 0.350$, $p < 0.001$), highlighting the importance of DT in achieving competitive advantages. Financial resources (FR) and human resources (HR) are equally critical for promoting innovation by providing consistent funding and talented talent. CG and innovation strategy (CGIS) have a minor impact, indirectly promoting innovation through strategic leadership. While the PL offers some assistance, it does not emerge as the dominant driver of innovation. Creative innovation bridges resources and competitiveness, emphasizing its critical role in transforming investments into long-term competitive advantage. The findings highlight the need for a comprehensive strategy that emphasizes technology, finance, human capital, and governance to encourage innovation. In Vietnam's orientation as a start-up nation, research on innovation for businesses, especially small and medium enterprises, needs more attention. From research articles from other countries, Vietnam can learn to apply tools to support small and medium enterprises in applying innovation effectively through practical support in training, capital, business consulting, promoting knowledge sharing, sharing resources and technology, and creating an innovation ecosystem. Although this study has some limitations that need to be recognized, it does provide significant information. It is possible that the study does not accurately reflect the variety of SMEs in more remote or rural parts of Vietnam as it only includes data from six large cities. Second, although the sample size ($n = 835$) is sufficient, it is cross-sectional, making it difficult to draw conclusions about cause and effect or track changes over time. Finally, the study could have some issues with response bias or subjectivity because it uses self-reported data from SME managers. Furthermore, the model fails to consider any outside forces (e.g., COVID-19 or economic volatility) that could impact innovation dynamics. Finally, as cultural and sectoral differences were not specifically controlled for, the results may not apply to other SMEs. It would benefit future research to follow participants over time to determine how their innovation potential and competitiveness evolve. It is possible to increase the generalizability and contextual richness of the results by broadening the sample to include SMEs in rural areas or other economic sectors. Qualitative methodologies, such as in-depth interviews or case studies, might be included to further understand the factors driving innovation at the corporate level. Factors such as leadership style, organizational learning, and digital maturity could mediate or moderate future studies. The innovation ecosystem in Vietnam can be compared to other developing economies through cross-national comparative studies. Finally, policymakers will benefit from studying how SMEs have changed and innovated after the pandemic to understand how they have dealt with digital disruption.

Acknowledgements

The authors thank the managers of small and medium enterprises and the Rector of Lac Hong University (LHU), Vietnam.

Author Contributions

The authors contributed equally to conceptualization, investigation, methodology, data analysis, and original draft.

Conflict of Interest

No potential conflict of interest was reported by the author.

References

Akpan, EE, Al-Faryan, MAS & Iromaka, JF 2022, 'Corporate governance and firm innovation: Evidence from indigenous oil firms in Sub-Saharan Africa', *Cogent Business & Management*, vol. 9, no. 1, article 2140747, https://doi.org/10.1080/23311975.2022.2140747

Albugami, MA & Zaheer, A 2023, 'Measuring E-commerce service quality for the adoption of online shopping during COVID-19: applying unified theory and use of technology model (UTAUT) model approach, *International Journal of Technology*, vol. 14, no. 4, pp. 705-712, https://doi.org/10.14716/ijtech.v14i4.5407

Aliasghar, O, Sadeghi, A & Rose, EL 2023, 'Process innovation in small-and medium-sized enterprises: The critical roles of external knowledge sourcing and absorptive capacity', *Journal of Small Business Management*, vol. 61, no. 4, pp. 1583-1610, https://doi.org/10.1080/00472778.2020.1844491

Andersen, TCK, Aagaard, A & Magnusson, M 2022, 'Exploring business model innovation in SMEs in a digital context: Organizing search behaviours, experimentation and decision-making', *Creativity and Innovation Management*, vol. 31, no. 1, pp. 19–34, https://doi.org/10.1111/caim.12474

Asriati, N, Syamsuri, S, Thoharudin, M, Wardani, SF & Kusuma Putra, AHP 2022, 'Analysis of business behavior and HRM perspectives on post-COVID-19 SME business sustainability', *Cogent Business & Management*, vol. 9, no. 1, pp. 1–21, https://doi.org/10.1080/23311975.2022.2115621

Azamela, JC, Tang, Z, Owusu, A, Egala, SB & Bruce, E 2022, 'The impact of institutional creativity and innovation capability on innovation performance of public sector organizations in Ghana', *Sustainability*, vol. 14, no. 3, pp. 1–18, https://doi.org/10.3390/su14031378

Bodlaj, M & Čater, B 2019, 'The impact of environmental turbulence on the perceived importance of innovation and innovativeness in SMEs', *Journal of Small Business Management*, vol. 57, no. 2, pp. 417–435, https://doi.org/10.1111/jsbm.12482

Bolsunovskaya, MV, Kudryavtseva, TY, Rudskaya, IA, Gintciak, AM, Zhidkov, DO, Fedyaevskaya, DE & Burlutskaya, ZV 2023, 'Digital platform for modeling the development of regional innovation systems of Russian Federation', *International Journal of Technology*, vol. 14, no. 8, pp. 1779–1789, https://doi.org/10.14716/ijtech.v14i8.6843

Bos-Nehles, AC & Veenendaal, AA 2019, 'Perceptions of HR practices and innovative work behavior: the moderating effect of an innovative climate', *The International Journal of Human Resource Management*, vol. 30, no. 18, pp. 2661-2683, https://doi.org/10.1080/09585192.2017.1380680

Celestine, GV 2024, 'The comparative advantage of digital and face-to-face data collection in 21st-Century research: evidence from agricultural research', *Torkwase Journal of Agricultural Research*, vol. 1, no. 1, pp. 10–17, https://www.torkwasejar.com/index.php/torkwasejar/article/view/2

Chatterjee, S, Chaudhuri, R, Vrontis, D & Basile, G 2022, 'Digital transformation and entrepreneurship process in SMEs of India: A moderating role of adoption of AI-CRM capability and strategic planning', *Journal of Strategy and Management*, vol. 15, no. 3, pp. 416–433, https://doi.org/10.1108/JSMA-02-2021-0049

Chege, SM, Wang, D & Suntu, SL 2020, 'Impact of information technology innovation on firm performance in Kenya', *Information Technology for Development*, vol. 26, no. 2, pp. 316-345, https://doi.org/10.1080/02681102.2019.1573717

Cheng, S, Fan, Q & Dagestani, AA 2023, 'Opening the black box between strategic vision on digitalization and SMEs digital transformation: the mediating role of resource orchestration', *Kybernetes*, vol. 53, no. 2, pp. 580–599, https://doi.org/10.1108/K-01-2023-0073.

Faeroevik, KH & Maehle, N 2022, 'The outcomes of cross-industry innovation for small and medium-sized enterprises', *Journal of Small Business & Entrepreneurship*, vol. 36, no. 4, pp. 675-704, https://doi.org/10.1080/08276331.2022.2070711

Fang, GG, Qalati, SA, Ostic, D, Shah, SMM & Mirani, MA 2022, 'Effects of entrepreneurial orientation, social media, and innovation capabilities on SME performance in emerging countries: A mediated–moderated

model', *Technology Analysis & Strategic Management*, vol. 34, no. 11, pp. 1326-1338, https://doi.org/10.1080/09537325.2021.1957816

Gao, WW, Lv, GC & Li, ZF 2023, 'The impact of government support on firm innovation: Evidence from China', *Managerial and Decision Economics*, vol. 44, no. 7, pp. 3907-3922, https://doi.org/10.1002/mde.3916

Ghosh, V, Sengupta, T, Narayanamurthy, G & Ishizaka, A 2021, 'Examining collective creative self-efficacy as a competency indicator of group talent management: a study of SMEs in an emerging economy', *The International Journal of Human Resource Management*, vol. 34, no. 6, pp. 1182–1212, https://doi.org/10.1080/09585192.2021.1988679

Giebel, M & Kraft, K 2019, 'External financing constraints and firm innovation', *Journal of Industrial Economics*, vol. 67, no. 1, pp. 91-126, https://doi.org/10.1111/joie.12197

Gong, Y, Yao, YH & Zan, A 2023, 'The too-much-of-a-good-thing effect of digitalization capability on radical innovation: The role of knowledge accumulation and knowledge integration capability', *Journal of Knowledge Management*, vol. 27, no. 6, pp. 1680-1701, https://doi.org/10.1108/jkm-05-2022-0352

Hair, J, Anderson, R, Tatham, R & Black, W 2018, *Multivariate data analysis*, Prentice-Hall, Upper Saddle River, NJ, USA

Harney, B & Alkhalaf, H 2021, 'A quarter-century review of HRM in small and medium-sized enterprises: Capturing what we know, exploring where we need to go', *Human Resource Management*, vol. 60, no. 1, pp. 5–29, https://doi.org/10.1002/hrm.22010

Harney, B, Gilman, M, Mayson, S & Raby, S 2022, 'Advancing understanding of HRM in small and medium-sized enterprises (SMEs): critical questions and future prospects', *The International Journal of Human Resource Management*, vol. 33, no. 16, pp. 3175-3196, https://doi.org/10.1080/09585192.2022.2109375

Hervas-Oliver, J-L, Sempere-Ripoll, F & Boronat-Moll, C 2021, 'Technological innovation typologies and open innovation in SMEs: Beyond internal and external sources of knowledge', *Technological Forecasting & Social Change*, vol. 162, article 120338, https://doi.org/10.1016/j.techfore.2020.120338

Hong, JF, Zhao, X & Stanley Snell, R 2019, 'Collaborative-based HRM practices and open innovation: A conceptual review', *The International Journal of Human Resource Management*, vol. 30, no. 1, pp. 31–62, https://doi.org/10.1080/09585192.2018.1511616

Islami, X & Mulolli, E 2024, 'Do training and development, internal communication and information sharing, and job design boost the innovation of SMEs?', *Cogent Business & Management*, vol. 11, no. 1, pp. 1-16, https://doi.org/10.1080/23311975.2024.2413912

Ivashchenko, A, Kornyliuk, A & Polishchuk, Y 2021, 'Innovation vouchers as a modern financial tool for the development of SMEs', *Baltic Journal of Economic Studies*, vol. 7, no. 5, pp. 78–87, https://doi.org/10.30525/2256-0742/2021-7-5-78-87

Kumar, V, Sindhwani, R, Behl, A, Kaur, A & Pereira, V 2023, 'Modelling and analysing the enablers of digital resilience for small and medium enterprises', *Journal of Enterprise Information Management*, vol. 37, no. 5, pp. 1677-1708, https://doi.org/10.1108/JEIM-01-2023-0002

Lin, CH, Sanders, K, Sun, JM, Shipton, H & Mooi, EA 2020, 'HRM and innovation: The mediating role of market-sensing capability and the moderating role of national power distance', *The International Journal of Human Resource Management*, vol. 31, no. 22, pp. 2840–2865, https://doi.org/10.1080/09585192.2018.1474938

Lu, H & Shaharudin, MS 2024, 'Role of digital transformation for sustainable competitive advantage of SMEs: A systematic literature review', *Cogent Business & Management*, vol. 11, no. 1, article 2419489, https://doi.org/10.1080/23311975.2024.2419489

Maarouf, A & Korableva, ON 2022, 'Credit constraints and innovation activities: empirical evidence on Russian enterprises', *International Journal of Technology*, vol. 13, no. 2, pp. 254-263, https://doi.org/10.14716/ijtech.v13i2.4835

Naruetharadhol, P, Srisathan, WA, Gebsombut, N, Wongthahan, P & Ketkaew, C 2022, 'Industry 4.0 for Thai SMEs: implementing open innovation as innovation capability management, *International Journal of Technology*, vol. 13, no. 1, pp. 48-57, https://doi.org/10.14716/ijtech.v13i1.4746

Ndiinee, MD & Gever, VC, 2025. Online vs face-to-face research participation: which do research respondents prefer?', *Mdooter Journal of Communication and Digital Technologies*, vol. 2, no. 1, pp. 1-7, https://www.mdooterj.com/index.php/mdooterj/article/view/6

Neverauskienė, LO, Danilevičienė, I & Tvaronavičienė, M 2020, 'Assessment of the factors influencing competitiveness fostering the country's sustainability', *Economic Research-Ekonomska Istraživanja*, vol. 33, no. 1, pp. 1909-1924, https://doi.org/10.1080/1331677X.2020.1763821

Nga, TTB 2024, 'Legal policy implications for promoting innovation capability and business efficiency: a case study of small and medium enterprises in Vietnam', *Ianna Journal of Interdisciplinary Studies*, vol. *6*, no. 2, pp. 212–224, https://iannajournalofinterdisciplinarystudies.com/index.php/1/article/view/260

Nhat, NM 2025, 'Technological investment and its effect on stock return and profitability: a study of Vietnamese commercial banks amid Fintech growth, *Ianna Journal of Interdisciplinary Studies*, vol. 7, no. 1, pp. 58-70, https://iannajournalofinterdisciplinarystudies.com/index.php/1/article/view/306

Park, C & McQuaid, R 2023, 'Enterprise policies and R&D support for high-tech SMEs: A multi-perspective approach', *Policy Studies*, vol. 46, no. 1, pp. 102-123, https://doi.org/10.1080/01442872.2023.2268530

Perez-Alaniz, M, Lenihan, H, Doran, J & Hewitt-Dundas, N 2022, 'Financial resources for research and innovation in small and larger firms: Is it a case of the more you have, the more you do?', *Industry and Innovation*, vol. 30, no. 2, pp. 189–232, https://doi.org/10.1080/13662716.2022.2036597

Prakasa, Y & Jumani, ZA 2024, 'Linking digital capability to small business performance: The mediating role of digital business transformation', *Cogent Business & Management*, vol. 11, no. 1, pp. 1-17, https://doi.org/10.1080/23311975.2024.2342486

Rădulescu, MA, Leendertse, W & Arts, J 2023, 'How can co-creation support capacity building for adaptive spatial planning? Exploring evidence from a co-creative planning process in The Netherlands', *Planning Theory & Practice*, vol. 24, no. 5, pp. 639–662, https://doi.org/10.1080/14649357.2023.2288203

Rumanti, AA, Rizana, AF, Septiningrum, L, Reynaldo, R & Isnaini, MM 2022, 'Innovation capability and open innovation for small and medium enterprises (SMEs) performance: Response in dealing with the COVID-19 pandemic', *Sustainability*, vol. 14, no. 10, article 5874, https://doi.org/10.3390/su14105874

Sabihaini, Kurniawan, A, Eko Prasetio, J & Rusdiyanto 2024, 'Environmental analysis and impact on green business strategy and performance in SMEs post the Covid-19 pandemic', *Cogent Economics & Finance*, vol. 12, no. 1, article 2330428, https://doi.org/10.1080/23322039.2024.2330428

Sepúlveda, ICQ & Collazos, AZ 2023, 'Innovation capabilities, innovation strategies and performance: An empirical analysis in SMEs', *Technology Analysis & Strategic Management*, vol. 37, no. 1, pp. 19–34, https://doi.org/10.1080/09537325.2023.2280523

Tyler, BB, Lahneman, B, Cerrato, D, Cruz, AD, Beukel, K, Spielmann, N & Minciullo, M 2023, 'Environmental practice adoption in SMEs: The effects of firm proactive orientation and regulatory pressure', *Journal of Small Business Management*, vol. 62, no. 5, pp. 2211–2246, https://doi.org/10.1080/00472778.2023.2218435

Ueasangkomsate, P 2025, 'Empowering Thai SMEs through IT competency, digitalization and digital transformation for new product development', *Cogent Business & Management*, vol. 12, no. 1, article 2458758, https://doi.org/10.1080/23311975.2025.2458758

Valdez-Juárez, LE, Ramos-Escobar, EA, Hernández-Ponce, OE & Ruiz-Zamora, JA 2024, 'Digital transformation and innovation, dynamic capabilities to strengthen the financial performance of Mexican SMEs: a sustainable approach', *Cogent Business & Management*, vol. 11, no. 1, article 2318635, https://doi.org/10.1080/23311975.2024.2318635

Yahaya, HD & Nadarajah, G 2023, 'Determining key factors influencing SMEs' performance: A systematic literature review and experts' verification', *Cogent Business & Management*, vol. 10, no. 3, article 2251195, https://doi.org/10.1080/23311975.2023.2251195

Yashin, S, Yashina, N, Koshelev, E, Ivanov, A & Zakharova, S 2023, 'Neural simulation of digital twin of top management motivation mechanism in regional government agencies', *International Journal of Technology*, vol. 14, no. 8, pp. 1643-1652, https://doi.org/10.14716/ijtech.v14i8.6840

Zainuri, Z, Yasin, MZ, Amijaya, RNF, Wilantari, RN & Vipindrartin, S 2024, 'The role of government policy on the performance of MSMEs in the creative industry: evidence from Jember Regency, East Java, Indonesia', *Cogent Economics & Finance*, vol. 13, no. 1, article 2446657, https://doi.org/10.1080/23322039.2024.2446657

Zhou, SS, Zhou, AJ, Feng, J & Jiang, S 2019, 'Dynamic capabilities and organizational performance: The mediating role of innovation', *Journal of Management & Organization*, vol. 25, no. 5, pp. 731-747, https://doi.org/10.1017/jmo.2017.20