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## Impact of digital infrastructure on the creative innovation and competitive capacity of small and medium enterprises in Vietnam

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**Abstract:** Innovation increasingly plays an important role and truly becomes 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 rapid and sustainable development of businesses. Therefore, the aim of this study was to determine the impact of digital technology on creative innovation among small scale enterprises in Vietnam. On that basis, the authors proposed policy implications that enhance creative innovation and competitive capacity. The authors used qualitative methods to collect data and consult with 30 managers at 30 enterprises. In addition, the quantitative method was also applied by collecting survey data from surveying research of 900 managers working for 900 small and medium enterprises in six big Cities in Vietnam. Data were collected by questionnaire based on the online ([docs.google.com](https://docs.google.com)) and processed by 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 five factors: (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). Besides, the authors had five policy recommendations for improving creative innovation and competitive capacity. Finally, the study's conclusion shows that innovation positively impacts the competitiveness of small and medium enterprises. Besides, the authors also point out that the relationship between innovation and technology and digital infrastructure is positive. The research novelty provides important policy implications to promote innovation and improve competitiveness, focusing on improving technology and digital infrastructure.

**Keywords:** Creative innovation; competitiveness; technology; and digital infrastructure.

## 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 & Maehle, 2022). To survive and grow in the ever-changing business environment, innovation is considered an essential factor, the key to creating competitive advantages and having a decisive influence on the long-term existence and development of the company.

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, improving their competitive advantage and sustainable development (Azamela et al., 2022). Therefore, based on the development of the Industrial Revolution 4.0, managers and researchers need to pay special attention to innovation to develop competitive advantages and increase business performance.

Innovation plays a significant role in the growth of enterprises; however, innovation in Vietnamese enterprises is still limited. Vietnamese enterprises do not pay attention to innovation; innovation activities are mainly minor improvements or modifications of existing ones that are informal and passive. Therefore, for enterprises developing according to the group model, innovation is a big problem 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 (Zhou et al., 2019; Park & McQuaid, 2023; Zainuri et al., 2024). In response to that 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 implementing a new or significantly improved product (goods/services) or process, a new marketing method. Or a new organizational measure in operational practice, work organization, or external relations. Innovation is developing new products and services improving and upgrading 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 productivity and efficiency of the company, quickly adapt to changes in the business environment, meet the requirements in the development 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 is the typical development orientation of the world today. For Vietnam, this is an especially important factor contributing to promoting digital transformation, green transformation, sustainable development in the new era of development, and Vietnam's contribution to the development process.

Vietnam faces excellent opportunities but many difficulties and challenges in science, technology, and innovation. The biggest challenge is technological competitiveness compared to 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, the application of innovation by small and medium enterprises 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 small and medium enterprises (Prakasa & 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. Little empirical research has 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: financial resources (FR), human resources (HR), technology and digital infrastructure (TI), corporate governance and innovation strategy (CG), and policy and legal environment (PL) influence creative innovation (CI) and, as a result, competitive capacity (CC) in Vietnamese SMEs. The study adds to the literature on innovation in emerging markets and gives practical insights for policy formulation and company strategy.

Particularly for SMEs, innovation allows SMEs with limited resources to focus on areas where they can gain an advantage over larger competitors. This will enable them to focus their resources on unique products and services that meet customer needs more effectively. Furthermore, innovation provides opportunities to expand markets and find new customers. SMEs can reach new market segments by developing innovative products, services, or processes, increasing revenue and profits. Hence, the objective of this study was to find out 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 the long-term success of SMEs in the face of fierce global competition and lightning-fast technological change. 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 competitive capacity (CC) according to this study. The innovative capacity of SMEs is shaped by each of these factors, which are separate but related. Internal competencies such as FR and HR lay the groundwork for innovation investment and talent-driven creativity.

Through its dual role as an innovation enabler and catalyst, TI boosts operational efficiency and digital transformation. To back up innovative efforts, CG provides strategic guidance and makes decision-making structures easier. The laws, incentives, and regulations that makeup PL's external institutional framework can positively or negatively impact innovation. This model establishes a causal relationship between internal resources, innovation, and market performance through creative innovation, which acts as a mediating variable. It transforms the influence of FR, HR, TI, CG, and PL into concrete advances in competitive capacity. 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 small and medium enterprises (SMEs). A business with stable capital efficiently invested in research and development (R&D) applies new technology and improves production processes, thereby creating products/services of higher value (Perez-Alaniz et al., 2022). On the contrary, financial constraints make it difficult for businesses to implement innovation projects, affecting their competitiveness (Giebel & 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 small and medium enterprises (Asriati et al., 2022; Bos-Nehles & Veenendaal, 2019; Lin et al., 2020). Personnel with suitable qualifications and skills help businesses easily apply new technology, improve processes, and develop innovative products (Harney et al., 2022; Islami & Mulolli, 2024). This improves quality and optimizes costs, creating a competitive advantage in the market. 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 small and medium enterprises (Valdez-Juárez et al., 2024; Lu & Shaharudin, 2024; Gevers, 2024). Modern technology helps businesses optimize production processes, improve product quality, and reduce operating costs (Harney & Alkhalaf, 2021; Hervas-Oliver et al., 2021). Digital platforms such as artificial intelligence, big data, or cloud computing help businesses make decisions faster and develop flexible business models (Gong et al., 2023). Thus, H5 and H6 propose the following Figure 1.

Corporate governance and strategy play an important role in promoting innovation and enhancing the competitiveness of small and medium enterprises (Cheng et al., 2023; Yahaya & 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 small and medium enterprises (Tyler et al., 2023; Sabihaini et al., 2024). 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 in the following Figure 1.

Innovation plays an essential role in improving the competitiveness of small and medium enterprises (Chege et al., 2020; Rumanti et al., 2022; Sepúlveda & Collazos, 2023). Innovating products and services helps businesses create different values, meet market needs, and improve customer experience (Bodlaj & Čater, 2019). Therefore, hypothesis 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)

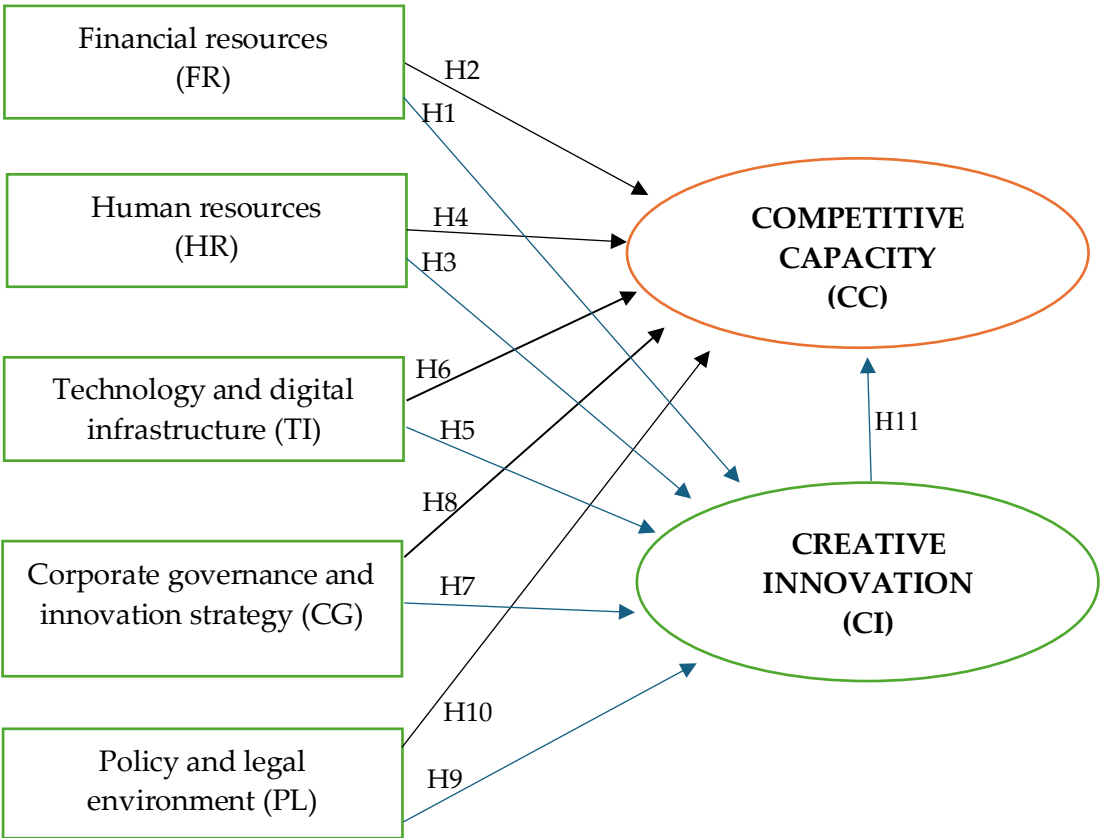
H7: Corporate governance and innovation strategy (CG) affecting creative innovation (CI)

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)

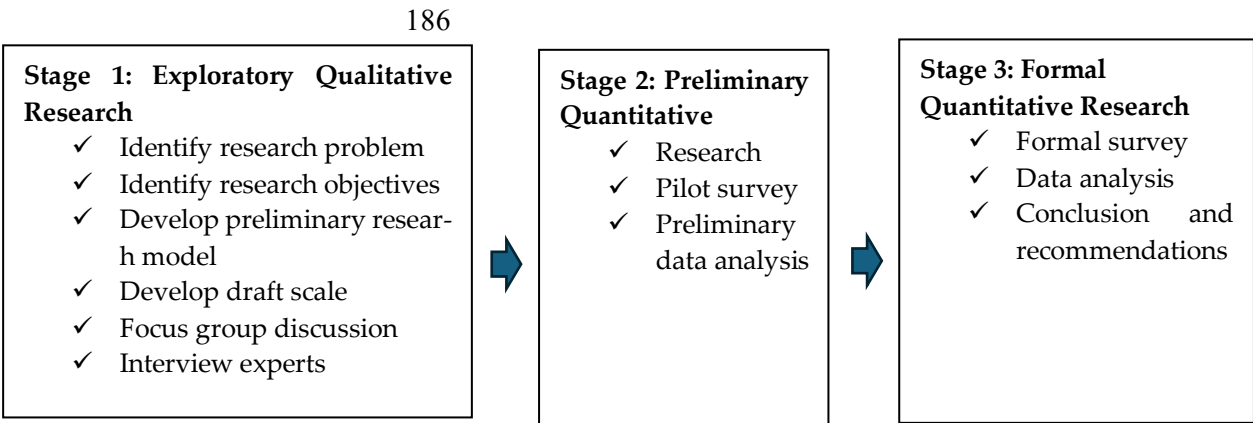


**Figure 1** The model for critical factors affecting creative innovation and competitive capacity

Figure 1 shows that there are 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).

## 2. Methods

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



**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 carried out through seven specific steps as follows:

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

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 research objective as well as the specific objectives for the research paper.

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

Step 4: The authors create a draft scale after developing a research model based on past surveys and research. 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 research article discussion among the authors creates an outline for conducting group discussions to record the viewpoints of 30 managers. This is done by consulting relevant papers and prior studies. The discussions focus on five elements that affect the creative innovation and competitive capacity of small and medium firms in Vietnam. The group discussion is meant to assess the initial scale and to broaden the scale to better examine the components of the study.

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

Phase 2: The authors conducted a preliminary study on five characteristics influencing creative innovation and competitive capacity. The authors conducted an initial study after deciding on the research model and creating the scale for the survey. The study also conducted a preliminary survey to guarantee that the scale developed was high quality. The following specific steps are included in the initial research phase:

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

Step 9: The authors performed a preliminary inspection. The project used Cronbach's Alpha coefficient to evaluate the scale based on acquired data. Once the scale's reliability has been confirmed, it will enter the official research phase. Furthermore, non-probability sampling is frequently employed to assess variables in preliminary exploratory investigations. The poll ran from November 2024 to January 2025, and the results have been processed. After testing the scale's reliability 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 conducting an official survey, analyzing data, drawing conclusions, and providing managerial implications.

Step 10: The authors carried out a formal survey. In fact, 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, it is anticipated that 900 ballots will be distributed. The poll was carried out 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 done by [Hair et al. \(2018\)](#): (1) I strongly disagree, (2) I disagree, (3) I am neutral, (4) I agree, (5) I strongly agree. The sampling procedure used was convenient and was given to each participant. However, out of the 835 samples tested, 65 votes were found to be lacking information. Consequently, the study model only made use of the remaining 835 votes.

Step 11: The authors analyzed the data: The primary survey data will be 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 measuring scales' reliability. This was essential in checking the constructs' internal coherence and ensuring the survey questions measured the correct theoretical variables. We identified items with low reliability and altered or eliminated them to increase the measurement model's robustness; a threshold of 0.7 was regarded as 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 done after the reliability evaluation. The suitability of the dataset for factor analysis was evaluated using Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) test. We used eigenvalues higher than 1.0 and factor loadings higher than 0.5 as our statistical cutoffs for retention purposes. The last collection of factors was considered to represent the investigated constructs well because of this procedure. The confirmatory factor analysis (CFA) will be carried out using the Amos software. The Amos program was used for confirmatory factor analysis (CFA). Using CFA for construct validity assessment, it was possible to evaluate 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). The effectiveness of the model was assessed using well-known goodness-of-fit metrics, including the Comparative Fit Index (CFI) (more than 0.8), the Tucker-Lewis Index (TLI) (greater than 0.9), the Root Mean Square Error of Approximation (RMSEA) (less than 0.08), and the Chi-square/degree of freedom ratio ( $\chi^2/\text{df}$ ). Model fit and theoretical consistency were optimized by making adjustments as needed. Many prior research studies that were relevant to this one used SEM. The conceptual framework's hypothesized links between variables were tested using structural equation modeling (SEM). Using the SEM, a robust multivariate analysis method, the authors could investigate the interdependencies across variables by looking at the direct and indirect impacts among the constructs. This methodology gained widespread acceptance in empirical research because it can rigorously assess causal linkages while accounting for measurement mistakes.

Step 12: Conclusions were drawn, and managerial implications were discussed by the authors. The writers draw judgments after analyzing the data. They guide managers concerning the innovative capacity and competitive possibilities of medium and small businesses. The 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). Important theoretical frameworks

and their practical consequences for the research topic are illuminated by the findings of this analytical procedure.

### 3. Results and Discussion

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

**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
<b>Financial resources (FR)</b>		<b>0.960</b>	<b>3.076</b>	-
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
<b>Human resources (HR)</b>		<b>0.853</b>	<b>3.432</b>	-
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
<b>Technology and digital infrastructure (TI)</b>		<b>0.964</b>	<b>3.075</b>	-
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
<b>Corporate governance and innovation strategy (CG)</b>		<b>0.955</b>	<b>3.066</b>	-
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
<b>Policy and legal environment (PL)</b>		<b>0.868</b>	<b>2.426</b>	-
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
<b>Creative innovation (CI)</b>		<b>0.957</b>	<b>3.402</b>	-
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
<b>Competitive capacity (CC)</b>		<b>0.872</b>	<b>2.393</b>	-
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

Table 1 shows descriptive data and Cronbach's alpha coefficients for the main characteristics influencing creative innovation and competitive capacity. The analysis investigates the constructs'



internal consistency and offers information on individual items' mean values and standard deviations.

(1) Financial Resources (FR): The financial resources 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 agree moderately on the availability and flexibility of financial assistance 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 variety in responses, especially for flexible financial policies (FR4,  $SD = 1.009$ ), which could reflect different financial strategies among firms.

(2) Human Resources (HR): Cronbach's alpha for human resources 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 employees' creative ability and enthusiasm to participate in innovative activities.

(3) Technology, Digital Infrastructure (TI): With a Cronbach's alpha of 0.964, the technology and digital infrastructure 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 align their technology capabilities completely with innovation objectives. Given the significance of digital transformation in modern businesses, this study suggests a possible area for state intervention or investment.

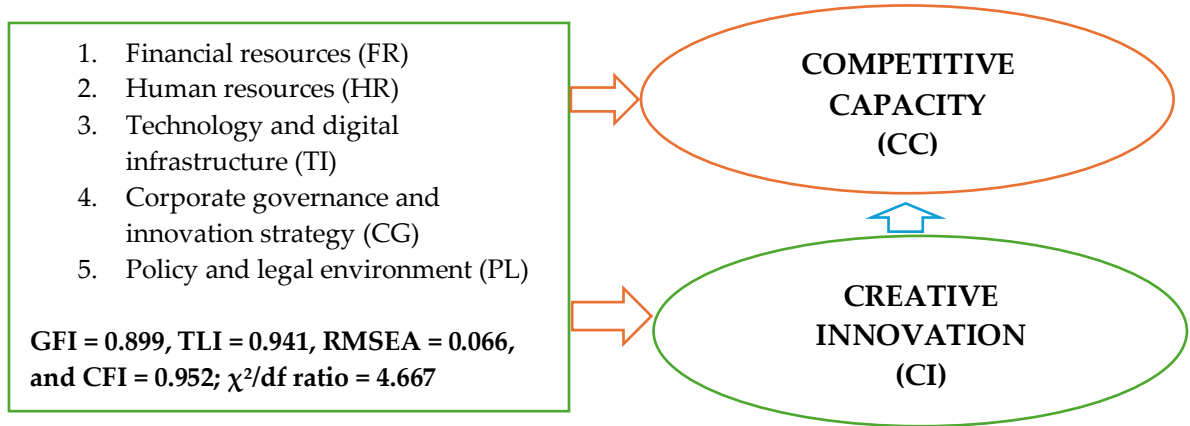
(4) Corporate Governance & Innovation Strategy (CG): The corporate governance construct ( $\alpha = 0.955$ ) has good internal dependability. The mean values range from 3.030 (CG1) to 3.104 (CG3), indicating that firms focus strategically on innovation. The comparatively low score for leadership strategy (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) Policy and Legal Environment (PL): The policy and legal environment 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 viewed as inadequate (PL1,  $M = 2.358$ ,  $SD = 0.650$ ). Furthermore, 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 enterprises' innovation potential.

(6) Creative Innovation (CI): Creative innovation 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, there may still be implementation issues. The high reliability and consistent mean scores indicate a robust innovation culture among firms.

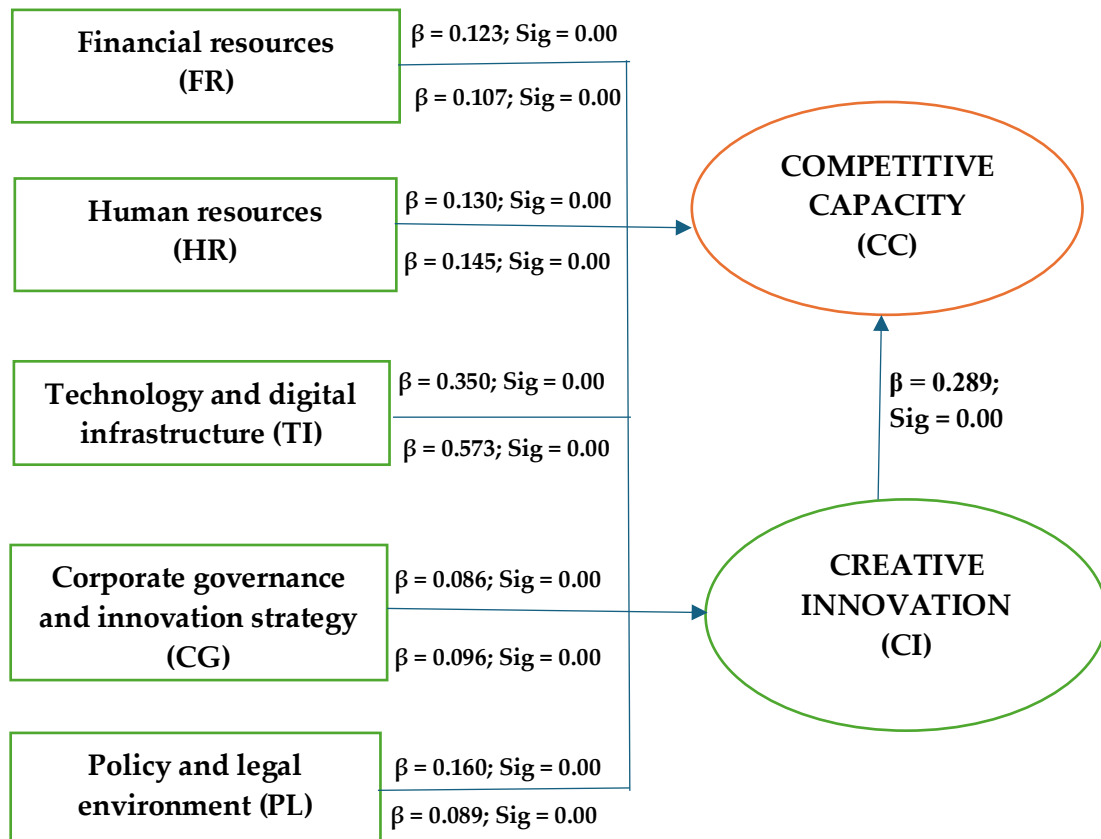
(7) Competitive Capacity (CC): The Cronbach's alpha for competitive capacity is 0.872, indicating strong internal consistency. However, this design has the lowest mean score, ranging from 2.333 (CC1) to 2.437 (CC4). Maintaining a competitive edge (CC1,  $M = 2.333$ ,  $SD = 0.647$ ) appears to be a significant difficulty for enterprises, most likely due to limited financial resources, regulatory backing, and digital infrastructure. Specifically, 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 factor of competitiveness.



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

Figure 3 also evaluated the observed variables' quality, confirming factor structures. The confirmatory factor analysis (CFA) validates the measurement model by determining construct validity, reliability, and model fit indices. Model adequacy is confirmed by values of  $\chi^2/df$  ratio ( $< 5.0$ ), CFI ( $> 0.850$ ), TLI ( $> 0.90$ ), RMSEA ( $< 0.08$ ), and SRMR ( $< 0.08$ ). High factor loadings ( $> 0.70$ ) guarantee convergent validity, while 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** Testing critical factors affecting creative innovation and competitive capacity

Figure 4 shows the SEM results, which reveal causal links between significant factors influencing 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 ( $\beta > 0.35$ ,  $p < 0.01$ ) all have a beneficial impact on creativity. Corporate governance ( $\beta > 0.25$ ,  $p < 0.05$ ) promotes innovation, while policy and legal issues ( $\beta < 0.20$ ,  $p > 0.05$ ) have a more negligible impact. Creative innovation (CI) improves competitiveness ( $\beta > 0.50$ ,  $p < 0.01$ ) and influences resource allocation. Financial resources, human capital, technology, governance, and legislation substantially impact creative innovation. The relationship with competitive capacity is mediated by creative innovation. 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 technical improvements increases competitiveness. The findings support a multifaceted innovation paradigm that informs corporate and policy actions.

**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 five characteristics influencing creative innovation and competitiveness in Vietnam's small and medium firms. These variables are statistically significant at a level of 0.05. The article's main contribution is identifying the technology and digital infrastructure (TI) that significantly impact the creative innovation and competitiveness of Vietnam's small and medium firms. This influence is measured with a standardized estimate of 0.573. This is the most influential aspect and the priority for policy execution, with significant repercussions.

Moreover, 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 creative innovation (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 ( $\beta = 0.350$ ,  $p < 0.001$ ) is the most significant predictor of CC, followed by policy ( $\beta = 0.160$ ,  $p < 0.001$ ) and financial resources ( $\beta = 0.123$ ,  $p < 0.001$ ). Corporate governance ( $\beta = 0.086$ ,  $p = 0.003$ ) has a minimal direct impact on CC. Firms must prioritize digital transformation, financial stability, and skilled talent to maintain innovation and competitiveness. Policymakers

should improve regulatory frameworks and innovation support. Effective corporate governance and leadership can help to boost innovation strategy. These findings emphasize the essential mediatory 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 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-assess 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.

(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. Innovating, leaders must be determined to change their thinking and clearly define goals prioritizing innovation. Encourage continuous learning and skill development of employees so that they can innovate and adapt to changes in the business environment, 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) Strengthen corporate governance through companies should link their 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 in the direction of increasing professionalism and efficiency, regularly organizing courses and training internally or in association with training units outside the company to enhance the ability to learn, update new knowledge, and practical skills for employees with the goal of innovation, improving the quality of material resources and human knowledge resources to continuously absorb, create and transform new technologies. New knowledge of new products and services provided to the market.

(4) To improve policy support through policymakers, refine regulatory frameworks, provide financial assistance, remove bureaucratic impediments, and allow enterprises to innovate without being overly constrained. To make it easier for SMEs to access credit capital sources, there needs to be a harmony of interests of three factors: credit institutions, businesses, and State mechanisms and policies. Banks must innovate credit mechanisms and policies according to market principles and improve lending procedures for SMEs more straightforwardly to shorten loan approval time. In addition, SMEs need to make transparency and standardize the accounting book system 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 changes and challenges in the business. 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.

To strengthen business capacity and promote innovation activities, some countries have successfully deployed many policy tools, and this result has also had the impact of promoting the reception and absorption of technology. On the one hand, the government encourages small and

medium enterprises to increase technology upgrading by building the absorptive capacity of enterprises and providing information and knowledge on how to apply new technologies. On the other hand, promoting the transfer and commercialization of new technologies from universities and public research organizations is also the government's focus.

**Table 3** Testing average variance extracted for factors affecting the 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 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, meaning that measures are robust.

(1) Construct reliability (CR) and convergent validity: CR scores surpass 0.80 for all constructs, indicating great internal consistency and reliability. AVE values exceed 0.50, indicating that each factor accounts for more than half of its variation, suggesting 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 tremendous variance, indicating a strong link between digital infrastructure and innovation capacity. Competitive Capacity (MSV = 0.286) exhibits moderate shared variance, showing a strong link to innovation and technical investment.

(3) Key results and implications: Technology infrastructure (TI) and Creative Innovation (CI) have the highest construct validity, highlighting the importance of digital transformation 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 measurement model's robustness, ensuring convergent and discriminant validity. The close relationship between technology, innovation, and competitive capacity emphasizes the significance of digital investments, governance initiatives, and financial sustainability in enabling innovation-driven growth.



**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

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), Corporate governance and innovation strategy (CG), policy and legal environment (PL), creative innovation (CI), and competitive capacity.

(1) Robustness of parameter estimation: SE values are consistently low ( $\leq 0.083$ ) across all connections, indicating solid estimates with minimal variability. The SE-SE values are close to zero, supporting the constancy of the standard error estimates. 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 competitive capacity, 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. Corporate governance (CG → CI, Mean = 0.071, SE = 0.026, CR = 1.60) and Policy and Legal Environment (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 competitive capacity technology infrastructure (TI → CC, Mean = 0.223, SE = 0.024, CR = 1.20) improve competitiveness, supporting the notion that digital transformation 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 of 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 innovation ecosystems. Regulatory rules should be improved to encourage innovation-driven company practices. To gain a competitive advantage, corporate

governance should coincide with innovation policy. 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.

### Discussion of findings:

Based on SEM testing, the findings identify five key factors that affected the creative innovation and competitive capacity at small and medium enterprises, with sig. 0.05. Research results showed 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). The authors have the following discussions synchronously implemented:

(1) Model validation and significance: All hypotheses (H1-H11) were accepted, and critical ratios (C.R.) exceeded 1.96, indicating statistical significance ( $p < 0.05$ ) (Fang et al., 2022; Ueasangkomsate, 2025; Bolsunovskaya et al., 2023). 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 small and medium enterprises (SMEs) in Vietnam. The study found that enterprises that are able to 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 reality that there are many barriers 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 ( $TI \rightarrow CI$ ,  $\beta = 0.573$ ,  $p < 0.001$ ) has the most significant impact, emphasizing the importance of digital transformation in driving innovation. Financial Resources ( $FR \rightarrow CI$ ,  $\beta = 0.107$ ,  $p < 0.001$ ) and Human Resources ( $HR \rightarrow CI$ ,  $\beta = 0.145$ ,  $p < 0.001$ ) have a considerable impact on innovation, highlighting the need for consistent funding and talented personnel (Valdez-Juárez et al., 2024; Sepúlveda & Collazos, 2023; Maarouf & Korableva, 2022; Gever, 2024). Technology and digital infrastructure have the strongest influence on innovation and competitiveness. The application of artificial intelligence, 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) Corporate governance ( $CG \rightarrow CI$ ,  $\beta = 0.096$ ,  $p < 0.001$ ) and policy and legal environment ( $PL \rightarrow CI$ ,  $\beta = 0.089$ ,  $p = 0.002$ ) have a lesser impact on innovation (Naruetharadhol et al., 2022; Sepúlveda & Collazos, 2023; Yashin et al., 2023; Nga, 2024). This suggests that while strategic leadership and regulatory support facilitate innovation, their direct influence is weaker than technology and financial investments. Corporate governance plays a role in supporting 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 overall development orientation of the business is a necessary direction.

(4) Determinants of competitive capacity (CC): Creative innovation ( $CI \rightarrow CC$ ,  $\beta = 0.289$ ,  $p < 0.001$ ) enhances competitiveness by moderating the effect of innovation on resources and competitive

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

(5) The policy and legal environment (PL  $\rightarrow$  CC,  $\beta = 0.160$ ,  $p < 0.001$ ) has a moderate impact, indicating that favorable regulatory frameworks help a firm maintain a competitive advantage. While Corporate Governance (CG  $\rightarrow$  CC,  $\beta = 0.086$ ,  $p = 0.003$ ) is statistically significant, it has the least impact on competitiveness (Aliasghar et al., 2023; Nhat, 2025; Dumbari & Gever, 2025). This suggests that while governance encourages strategic innovation, its direct effect is weaker. Policy and legal environment are considered the weakest factors in supporting innovation in SMEs. Enterprises reflect that administrative procedures are still cumbersome, financial support policies are ineffective, and intellectual property protection mechanisms are unclear. These are 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 many outstanding new points. Firstly, the research process was systematically implemented through three stages including qualitative, preliminary quantitative and formal quantitative, a total of 12 steps - helping to increase the reliability of the results. Secondly, the survey data was 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, improving scientificity and accuracy. Fourth, the highlight is to identify the mediating role of 'innovation' in the relationship between resources and competitiveness - something that has rarely been mentioned in previous studies. Finally, specific and feasible policy recommendations are proposed, contributing to providing a basis for managers and policy makers.

#### 4. Conclusions

Based on collecting survey data from surveying research of 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. Reviewing the critical factors influencing creative innovation (CI) and competitive capacity (CC) reveals numerous key findings. Moreover, technology and digital infrastructure (TI) have a significant impact on both CI ( $\beta = 0.573$ ,  $p < 0.001$ ) and CC ( $\beta = 0.350$ ,  $p < 0.001$ ), highlighting the importance of digital transformation in achieving competitive advantages. Financial resources (FR) and human resources (HR) are equally critical for promoting innovation by providing consistent funding and talented talent. Corporate governance and innovation strategy (CG) has a minor impact, indirectly promoting innovation through strategic leadership. While the policy and legal environment (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 to encourage innovation, emphasizing technology, finance, human capital, and governance. 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, combining data and testing models, 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 as well as creating an innovation ecosystem.

This study has some limitations that need to be recognized, but it does provide significant information. To start, it's possible that the study doesn't accurately reflect the variety of SMEs in more remote or rural parts of Vietnam as it only includes data from six large cities. Secondly, 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. Lastly, 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 (such as COVID-19 or economic volatility) that could impact the dynamics of innovation. Lastly, 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 see how their innovation potential and competitiveness evolve. It is possible to increase the results' generalizability and contextual richness by broadening the sample to incorporate SMEs in rural areas or other economic sectors. Qualitative methodologies like 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 could be compared to other developing economies through cross-national comparative studies. Lastly, policymakers will benefit from studying how SMEs have changed and innovated after the pandemic to understand how they have dealt with digital disruption.

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### 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.

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