Applied Data Science for Testing the Impact of Intangible Resources on Business Performance of SMEs

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Abstract

This study investigates how intangible resources influence business performance in small and medium-sized enterprises in Vietnam by applying structural equation modeling within an applied data science framework. The research aims to clarify the direct and indirect mechanisms through which key intangible components, such as human capital, structural capital, relationship capital, organizational culture, and brand image, shape enterprise outcomes. It also examines the mediating role of creative innovation and the moderating influence of operating time. The study employs a mixed-method design, beginning with qualitative interviews with enterprise managers to validate and refine measurement constructs, followed by a quantitative survey of managers in two major economic regions in Vietnam. Data were analyzed using an advanced structural modeling approach to assess reliability, validity, and the strength of causal relationships. The findings demonstrate that intangible resources act as a robust foundation for firm success, exerting strong positive effects on both creative innovation and overall business performance. All five resource dimensions significantly contribute to the higher-order construct, with relationship capital and organizational culture emerging as the most influential drivers. Creative innovation partially mediates the relationship between intangible resources and business performance, illustrating how firms convert knowledge-based assets into tangible outcomes through idea generation and implementation. Further, operating time strengthens this relationship, indicating that more established firms leverage their intangible foundations more effectively. The study contributes to ongoing discussions on resource-based competitiveness by extending theoretical perspectives to an emerging market context. It highlights the strategic importance of cultivating intangible resources to foster innovation capability and sustain long-term performance. The results offer practical implications for managers and policymakers seeking to develop knowledge-driven and innovation-oriented enterprises in dynamic economic environments.

Keywords: Intangible Resources, Creative Innovation, Business Performance, SMES, Structural Equation Modeling

1. Introduction

Small And Medium-Sized Enterprises (SMEs) play a crucial role in national economic growth, job creation, and innovation, particularly in emerging economies such as Vietnam. According to the Ministry of Planning and Investment, SMEs account for more than 97% of registered enterprises and contribute roughly 45% of the national GDP. However, in the era of globalization, digital transformation, and the knowledge economy, tangible assets such as machinery, equipment, or financial capital are no longer the only determinants of competitive advantage [1]. Instead, intangible resources (IR), including human knowledge, managerial capability, organizational culture, relational networks, and brand reputation, have become the core drivers of sustainable performance and innovation capacity.

The Resource-Based View (RBV) of the firm argues that organizations gain a competitive advantage when they possess valuable, rare, inimitable, and non-substitutable resources. In this framework, intangible resources, rather than physical or financial assets, create enduring value [2]. The Intellectual Capital Theory (ICT) further specifies that intangible resources consist of three foundational components: human capital (HC), structural capital (SC), and relationship capital (RC). Later studies have extended this taxonomy to include organizational culture (OC) and brand image (BI) as critical subdimensions that shape employees' behavior, innovation orientation, and customer trust. Together, these components form a multidimensional construct that defines a firm's internal strength and its ability to transform

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knowledge into performance outcomes [3]. Despite growing scholarly attention, empirical evidence on how intangible resources affect business performance (BP) in developing countries remains limited. Many previous studies have been conducted in high-income contexts, where institutional quality, digital infrastructure, and human capital accumulation differ significantly from those in transitional economies like Vietnam. Furthermore, most local studies adopt descriptive or regression-based approaches, which fail to capture the complex, interdependent relationships among intangible resources, innovation, and firm outcomes. This gap calls for applying advanced data-driven analytical techniques, such as Structural Equation Modeling (SEM), within the broader field of Applied Data Science to provide a more rigorous understanding of these dynamics.

The present study seeks to address this gap by investigating the impact of intangible resources on the business performance of Vietnamese SMEs, emphasizing both the direct and indirect mechanisms through creative innovation (CI). Creative innovation represents a firm's ability to generate, develop, and implement novel ideas, products, or processes. It acts as a mediating mechanism through which intangible resources are transformed into measurable business outcomes [1], [4]. Moreover, the study incorporates operating time (OT) as a moderating factor on the premise that firms with longer operational histories tend to leverage intangible resources more effectively through accumulated experience, learning, and network effects.

Methodologically, this research follows a mixed-method design. A qualitative phase with 45 enterprise managers helped refine the conceptual model and ensure the cultural appropriateness of measurement items. Subsequently, a quantitative survey was conducted with many SME managers in Dong Nai and Ho Chi Minh City between February and May 2025, resulting in valid responses. Using SmartPLS 4.0, the study tested the proposed hypotheses through SEM, evaluating both measurement reliability (Cronbach's alpha, composite reliability, average variance extracted) and structural paths.

The results demonstrate that intangible resources exert strong positive effects on both creative innovation and business performance. All five subdimensions, including human capital, structural capital, relationship capital, organizational culture, and brand image, on the higher-order construct of intangible resources, confirming their theoretical coherence. Additionally, creative innovation significantly mediates the IR–BP relationship, while operating time positively moderates it. These findings provide robust empirical evidence that intangible assets underpin competitiveness and innovation in SMEs.

Finally, this study contributes to the literature by extending the RBV and ICT frameworks into the context of emerging markets through an applied data science approach. It highlights the importance of managing intangible resources as strategic assets. It provides practical insights for SME managers and policymakers aiming to foster innovation-led growth and long-term business performance in Vietnam's knowledge-driven economy.

2. Literature Empirical Review and Hypothesis Development

2.1. Intangible Resources (IR)

IR are non-physical assets that provide firms with sustainable competitive advantages through knowledge, experience, reputation, and organizational capabilities [5]. Unlike tangible assets, which are easily imitated or replaced, intangible resources are embedded in human behavior, organizational routines, and relational networks, making them difficult to replicate. According to the Resource-Based View (RBV), these resources meet the criteria of being valuable, rare, inimitable, and non-substitutable (VRIN), thus forming the foundation for long-term success [6].

Drawing on the Intellectual Capital Theory (ICT), intangible resources are typically structured into five main dimensions: human capital (HC), which reflects employees' competencies and creativity; structural capital (SC), representing organizational processes and systems; relationship capital (RC), referring to external networks and stakeholder trust; organizational culture (OC), expressing shared values and innovation orientation; and brand image (BI), encompassing reputation and market perception [3], [5], [7]. Collectively, these dimensions enhance a firm's creative innovation and ultimately drive superior business performance (BP), particularly in knowledge-intensive, rapidly changing environments such as those of SMEs in Vietnam. Several hypotheses (H1–H5) reflect relationships between intangible resources and their own subdimensions, which may appear tautological given the second-order construct structure. These hypotheses were retained not to establish causality but to empirically validate the formative–

reflective composition of intangible resources within the Vietnamese SME context. Nonetheless, acknowledging this conceptual redundancy is important, and future studies may focus on higher-order modeling without separately hypothesizing relationships that are structurally inherent to the construct definition.

While the study draws on both the Resource-Based View and Intellectual Capital Theory, a more apparent distinction between their underlying assumptions is needed to strengthen the model's theoretical coherence. The Resource-Based View emphasizes strategic resources that are valuable, rare, inimitable, and non-substitutable, focusing primarily on how firms secure competitive advantage through internal heterogeneity. Intellectual Capital Theory, by contrast, conceptualizes intangible resources as dynamic knowledge components, such as human, structural, and relational, that evolve through learning and interaction. These perspectives are complementary yet not identical. RBV treats resources as relatively stable strategic assets, whereas ICT emphasizes continuous knowledge development and value-creation processes. Acknowledging this distinction clarifies why both theories are needed: RBV explains why intangible resources matter strategically, whereas ICT describes how they operate and interact to generate innovation and performance. Recognizing these tensions and complementarities strengthens the justification for combining the two frameworks.

2.2. Business Performance (BP)

BP refers to the extent to which an enterprise achieves its strategic and operational objectives through the effective use of resources and capabilities. In the context of SMEs, BP is a multidimensional construct that encompasses both financial and non-financial indicators [6], [8]. Financial performance reflects profitability, revenue growth, productivity, and return on investment, while non-financial performance includes customer satisfaction, innovation capacity, employee commitment, and market reputation. According to the Resource-Based View (RBV), business performance results from the efficient deployment of internal resources, particularly intangible ones, that enable firms to develop distinctive competencies and sustain competitive advantages. Prior studies have emphasized that firms rich in intellectual capital, comprising human, structural, and relational assets, tend to outperform others in dynamic markets [5], [9]. In this study, BP is conceptualized as the outcome variable that captures the combined effects of intangible resources and creative innovation, representing the overall success and adaptability of SMEs in Vietnam's competitive business environment.

2.3. Human Capital (HC)

HC comprises the knowledge, skills, creativity, and experience of employees that contribute to organizational effectiveness and innovation. It is the foundation of a firm's intellectual capital, as individuals apply their expertise to solve problems, develop new ideas, and improve processes [3], [10]. According to the Resource-Based View (RBV), human capital is a strategic resource that fulfills the VRIN criteria: valuable, rare, inimitable, and non-substitutable, making it essential for sustaining competitive advantage. In SMEs, where resource constraints are typical, the quality and adaptability of human capital often determine a firm's ability to innovate and respond to market changes [11]. Intangible resources such as organizational culture, leadership, and knowledge management systems enhance employees' ability to apply and expand their competencies. Thus, the effective development and utilization of intangible resources are expected to influence human capital formation and performance positively, and the authors hypothesized H1 in figure 1.

2.4. Structural Capital (SC)

SC refers to the organizational systems, processes, databases, and technologies that support employees in creating and applying knowledge effectively. It represents the institutionalized knowledge that remains within the firm even when individuals leave, such as operating procedures, information systems, patents, and management structures [5], [12]. According to the Intellectual Capital Theory (ICT), structural capital acts as the backbone of organizational efficiency and innovation, facilitating the conversion of individual expertise into collective organizational capability. In SMEs, well-developed structural capital enables better coordination, faster decision-making, and improved knowledge sharing, key factors for maintaining competitiveness in dynamic environments [13]. When intangible resources are effectively managed, they enhance the development of structural capital by improving organizational routines, information flows, and technological integration. Consequently, firms with richer intangible assets tend to build stronger internal structures that foster innovation and performance. The authors formulated hypothesis H2 in figure 1.

2.5. Relationship Capital (RC)

RC comprises the network of relationships a firm maintains with external stakeholders, including customers, suppliers, partners, government agencies, and the broader community. It reflects the level of trust, loyalty, and mutual commitment developed through continuous interactions and cooperation [7], [14]. According to the Resource-Based View (RBV), strong relational networks enhance access to market information, resources, and opportunities that competitors find difficult to imitate. In SMEs, relationship capital is particularly critical because it compensates for limited tangible resources and facilitates business growth through collaboration and reputation. Intangible resources such as brand image, organizational culture, and leadership credibility play a central role in nurturing these relationships by shaping perceptions of reliability and professionalism [13], [15]. Therefore, firms with a more substantial base of intangible resources are more likely to develop enduring relationships that support long-term performance and innovation, and the authors had hypothesis H3 in figure 1.

2.6. Organizational Culture (OC)

OC refers to the shared values, beliefs, norms, and behavioral patterns that shape how employees interact, make decisions, and pursue organizational goals. It shapes a firm's social and psychological environment, influencing motivation, communication, and innovation [7], [16]. A strong, adaptive culture encourages openness to change, collaboration, and continuous learning, all vital for SMEs operating in dynamic, competitive markets. Within the Resource-Based View (RBV) framework, organizational culture is a distinctive intangible asset deeply embedded in the organization's identity, making it difficult for competitors to replicate [17]. Intangible resources such as leadership vision, knowledge-sharing systems, and brand values reinforce a culture of commitment and innovation [15], [18]. Consequently, effective management of intangible resources enhances cultural cohesion and alignment with strategic objectives, thereby promoting overall performance and innovation capacity. The authors hypothesized H4 in figure 1.

2.7. Brand Image (BI)

BI reflects the perceptions, associations, and emotional connections that stakeholders, customers, partners, and the public hold toward a firm. It represents the external manifestation of a company's identity, combining reputation, credibility, and the quality of relationships built over time [19]. A strong brand image enhances customer trust, loyalty, and a willingness to engage in long-term relationships, which, in turn, contribute to sustainable competitive advantage [20]. Within the Resource-Based View (RBV), brand image is considered a strategic intangible resource that meets the VRIN criteria: valuable, rare, inimitable, and non-substitutable. For SMEs, cultivating a positive brand image is particularly crucial, as it helps overcome constraints related to firm size, visibility, and financial resources [19], [21]. Intangible resources such as organizational culture, relationship capital, and human capital collectively strengthen brand identity and market positioning. Therefore, effective management of intangible resources significantly enhances brand image and market performance. The authors had hypothesis H5 in figure 1.

2.8. Intangible Resources (IR) affecting Business Performance (BP).

The relationship between Intangible Resources (IR) and Business Performance (BP) has been a central theme in strategic management research. According to the Resource-Based View (RBV), firms that effectively develop and integrate intangible resources can achieve superior and sustainable performance [22], [23]. These resources, comprising human, structural, relational, cultural, and brand-related assets, form the underlying capability that enables organizations to innovate, adapt, and compete in dynamic markets [20], [24]. Unlike tangible assets, intangible resources generate cumulative and synergistic effects that enhance productivity, efficiency, and innovation outcomes over time.

For SMEs, managing intangible resources strategically is particularly vital, as they often operate under financial and technological constraints. Firms that successfully leverage knowledge, relationships, and culture can convert these assets into innovation and improved market performance [25], [26]. Hence, understanding how IR directly contributes to BP provides valuable insights into sustaining growth and competitiveness in emerging economies such as Vietnam. The authors had hypothesis H6 in figure 1.

2.9. Intangible Resources (IR) affecting Creative Innovation (CI).

Creative Innovation (CI) refers to a firm's ability to generate and implement new ideas, products, or processes that enhance competitiveness and adaptability in a dynamic business environment. It is widely recognized as a key mechanism for transforming intangible resources (IR) into sustainable performance outcomes [27], [28]. According to the Resource-Based View (RBV) and Knowledge-Based Theory, intangible resources such as skilled employees, effective organizational structures, strong relationships, and an innovation-oriented culture form the foundation for creativity and knowledge application [29]. In SMEs, where flexibility and responsiveness are essential, the development of intangible assets enables cross-functional collaboration, learning, and experimentation, core elements of creative innovation. When human capital, structural capital, and organizational culture interact effectively, they stimulate idea generation and support the successful execution of innovative initiatives [30], [31]. Therefore, firms with strong intangible resources are better positioned to achieve higher levels of innovation capability. The authors had hypothesis H7 in **Figure 1**.

2.10. Creative Innovation (CI) affecting Business Performance (BP).

Creative innovation (CI) is a critical driver of organizational success, reflecting a firm's ability to transform ideas into valuable products, services, or processes. It enhances competitiveness by improving efficiency, customer satisfaction, and market differentiation [26], [31]. According to the Resource-Based View (RBV) and Innovation Theory, innovation acts as a bridge between a firm's internal resources and its external performance outcomes [32], [33]. When enterprises effectively apply creative innovation, they can better exploit opportunities, respond to environmental changes, and sustain long-term growth. For SMEs, innovation is particularly vital because it allows them to overcome size and resource limitations by leveraging flexibility and knowledge [34], [35]. Firms that foster creativity and experimentation tend to develop unique solutions that lead to increased productivity and profitability. As a result, innovation capability becomes a central factor linking intangible resources to overall business success. The authors had hypothesis H8 in figure 1.

2.11. Operating Time (OT) is a moderating factor that strengthens the relationship between Intangible Resources (IR) and Business Performance (BP).

Operating Time (OT), or the number of years a firm has been in operation, represents its accumulated experience, learning capacity, and organizational maturity [36]. Over time, enterprises develop deeper knowledge of markets, customers, and internal processes, enabling them to exploit opportunities and leverage intangible resources (IR) more effectively [37]. According to organizational learning theory, more established firms possess greater absorptive capacity, the ability to acquire, assimilate, and apply knowledge effectively, which enhances their ability to convert intangible assets into superior performance outcomes [38]. In the context of SMEs, firms with longer operating histories are more likely to have established management systems, stronger relationships, and a more stable culture, thereby amplifying the effects of intangible resources on business performance (BP). Conversely, younger firms may not yet have developed the necessary structures or experience to capitalize on these assets fully [39]. Operating Time (OT) positively moderates the relationship between Intangible Resources (IR) and Business Performance (BP). The authors had hypothesis H9 in figure 1.

The literature review occasionally relies on stacked citations without sufficient analytical synthesis, thereby weakening the depth of scholarly engagement. The study should more explicitly articulate how prior studies converge, diverge, or leave conceptual gaps that the present study addresses. Strengthening the integrative critique of existing research would enhance theoretical grounding and clarify the contribution to ongoing academic dialogues on intangible resources, innovation, and SME performance. The framework integrates the RBV and Intellectual Capital Theory (ICT), emphasizing that strategically managing intangible resources fosters innovation and drives superior performance in the dynamic, competitive environment of Vietnamese SMEs, as hypothesized in figure 1.

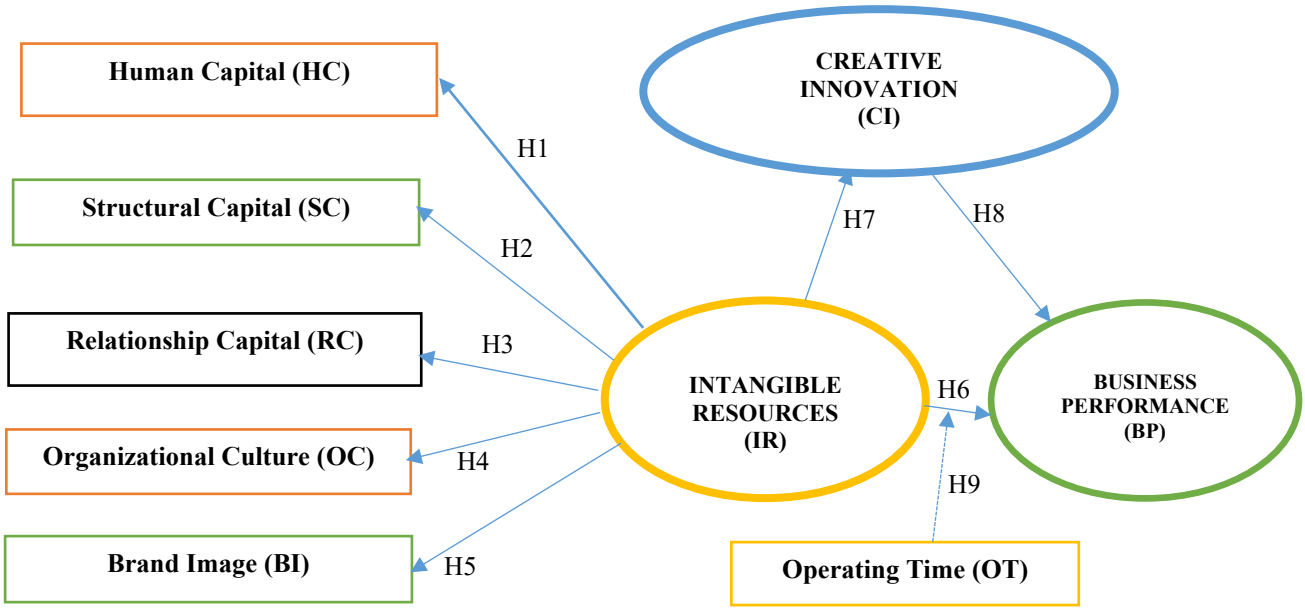

Figure 1. A study model for intangible resources affecting business performance

Figure 1 illustrates the proposed research framework examining how intangible resources (IR) influence business performance (BP) in small and medium-sized enterprises (SMEs). The model conceptualizes IR as a higher-order construct composed of five dimensions: human capital (HC), structural capital (SC), relationship capital (RC), organizational culture (OC), and brand image (BI). These components collectively strengthen a firm's ability to generate creative innovation (CI), which acts as a mediating variable linking IR to BP. Additionally, operating time (OT) is introduced as a moderating factor that reinforces the positive relationship between IR and BP, reflecting how organizational maturity and accumulated experience enhance the effectiveness of intangible resources.

3. Methodology and Data

3.1. Qualitative Research

The qualitative phase was conducted as the foundation for developing reliable measurement scales and ensuring the contextual relevance of the research model within the Vietnamese SME environment. This phase aimed to identify the key dimensions of Intangible Resources (IR) and their perceived influence on Creative Innovation (CI) and Business Performance (BP). A total of 45 in-depth interviews were carried out with enterprise managers, executives, and business owners from various industries in Dong Nai and Ho Chi Minh City between December 2024 and January 2025. Participants were purposefully selected based on their managerial experience, firm size, and industry diversity to ensure comprehensive insights [40].

Semi-structured interview guides were developed based on previous studies on Resource-Based View (RBV) and Intellectual Capital Theory (ICT). The interviews focused on identifying the intangible elements most relevant to Vietnamese SMEs, such as employee competencies, organizational structure, relationship networks, cultural characteristics, and brand reputation and on how these resources contribute to innovation and performance outcomes.

The data were analyzed using thematic analysis, following the procedures of coding, categorization, and theme development. Common patterns were identified and compared with existing literature to refine and adapt measurement items for the quantitative survey. The results confirmed five main subdimensions of intangible resources: human capital, structural capital, relationship capital, organizational culture, and brand image. The qualitative findings not only validated the conceptual framework but also ensured the clarity, linguistic appropriateness, and cultural suitability of the questionnaire used in the subsequent quantitative phase [40].

Although the study employs a mixed-method design, a deeper reflection on the integration between the qualitative and quantitative phases is warranted. The qualitative interviews did more than provide general validation; they played a

central role in refining construct definitions, identifying context-specific expressions of intangible resources, and eliminating redundant or culturally ambiguous items that may not align with the Vietnamese SME environment. Insights from managers also clarified how local enterprises conceptualize creativity, relational networks, and organizational culture, which directly informed the wording, structure, and contextual relevance of the survey instrument. However, the extent of this integration is not fully articulated in the manuscript, which may give the impression of limited methodological cohesion. Future studies could enhance transparency by more explicitly documenting how qualitative themes guided item generation, scale modification, and hypothesis refinement. Such clarification would strengthen methodological rigor and demonstrate the value of qualitative insights in shaping subsequent quantitative analysis.

3.2. Quantitative Research

The quantitative phase aimed to empirically test the proposed structural model and hypotheses developed from the qualitative findings. It focused on measuring the relationships among Intangible Resources (IR), Creative Innovation (CI), Business Performance (BP), and the moderating effect of Operating Time (OT). This phase employed a cross-sectional survey design with structured questionnaires to collect primary data from managers of small- and medium-sized enterprises (SMEs) in Vietnam.

3.2.1. Research Design and Data Collection

A survey questionnaire was developed based on the validated scales from previous studies and the results of the qualitative phase. The measurement items were designed using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). Before distribution, the questionnaire was reviewed by three academic experts and five SME managers to ensure content validity, linguistic clarity, and cultural appropriateness. The official survey was conducted between February 2025 and May 2025 in Dong Nai Province and Ho Chi Minh City, two major economic hubs in southern Vietnam where SMEs are highly concentrated. A total of 700 questionnaires were distributed through both in-person and online channels. After screening for missing data and inconsistencies, 663 valid responses were retained for analysis, representing a 94.7% effective response rate. This sample size met the minimum requirement for Structural Equation Modeling (SEM), which suggests at least ten observations per parameter estimate [40].

3.2.2. Measurement of Variables

All constructs were adapted from established studies to ensure validity and reliability: Human Capital (HC), which measures employees' knowledge, skills, and creativity. Structural Capital (SC) assesses internal systems, databases, and organizational processes. Relationship Capital (RC) measures the quality of relationships with customers, suppliers, and partners. Organizational Culture (OC) focuses on shared values and innovation orientation. Brand Image (BI) evaluates reputation, credibility, and market perception. Creative Innovation (CI) captures the capability for generating and implementing ideas. Business Performance (BP) combines financial and non-financial indicators. Operating Time (OT) is measured as the number of years since the firm's establishment and is used as a moderating variable. All items were measured on a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree. The measurement scales were adapted from established instruments in prior studies and modified to fit the Vietnamese SME context. The final questionnaire was translated into Vietnamese and back-translated into English to ensure linguistic equivalence and conceptual accuracy [40].

3.2.3. Data Analysis Procedures

Data were analyzed using SmartPLS 4.0 under the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach, which is suitable for both predictive and exploratory research with complex models. The analysis consisted of two main stages. Measurement model assessment - This step evaluated reliability and validity using Cronbach's alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). Convergent validity was confirmed as all factor loadings exceeded 0.70, and AVE values were above 0.50. Discriminant validity was verified using the Fornell–Larcker criterion. The relationships between latent variables were tested through path coefficients (β), t-statistics, and p-values, obtained from bootstrapping with 5.000 resamples. The model's predictive power was examined using R^2 and Q^2 values, while Standardized Root Mean Square Residual (SRMR) assessed the overall model fit [40]. Because all data were collected via self-reported surveys from a single respondent group, the potential for common-method bias warrants attention. Although procedural remedies were applied through item refinement and anonymity assurances,

the study did not test for bias statistically. Future research should incorporate diagnostic techniques, such as Harman's single-factor test, marker-variable approaches, or complete collinearity assessments to determine whether method effects inflate correlations among constructs. Although SmartPLS 4.0 was employed, a more apparent justification is warranted. PLS-SEM was selected due to the model's higher-order construct structure, non-normal data tendencies, and the study's emphasis on variance explanation. However, the largely confirmatory nature of the model suggests that CB-SEM could also be appropriate. Acknowledging this methodological trade-off enhances transparency and strengthens the study's analytical rationale.

4. Empirical Results

4.1. Demographic Characteristics of Respondents

A total of 700 questionnaires were distributed to managers of small and medium-sized enterprises (SMEs) in Dong Nai and Ho Chi Minh City. After eliminating incomplete and invalid responses, 663 valid questionnaires were retained for analysis, yielding a high response rate of 94.7% and ensuring reliability and statistical adequacy for structural equation modeling. The demographic characteristics of the respondents provide valuable insight into the composition of SME management in southern Vietnam.

Gender distribution: Out of 663 respondents, 59.3% were male (393 individuals) and 40.7% were female (270 individuals). This distribution reflects the current gender structure in Vietnam's business management sector, where men still occupy a majority of managerial positions, especially in manufacturing and service-oriented SMEs. Nevertheless, the substantial representation of female managers (over 40%) indicates growing gender diversity in leadership roles, consistent with the national trend of increased women's participation in entrepreneurial activities and business ownership. Marital Status: 62.1% of respondents were single, while 37.9% were married. The relatively high proportion of single respondents suggests that many SME managers belong to an earlier, career-focused demographic, in the early to middle stages of their professional development. This finding aligns with the age distribution, which shows that most respondents are under 40, indicating a young, dynamic managerial workforce in the SME sector.

Age distribution: The majority of respondents were between 30 and 40 years old (52.8%), followed by those aged 25 to 29 (24%). Managers aged 40 or older accounted for 15.7%, while only 7.5% were under 25. This indicates that most SME managers are in their prime working years, possessing both experience and adaptability, key attributes for managing innovation and change. The age composition suggests a management cohort capable of strategic decision-making while remaining receptive to technological transformation and innovation. Income Level: Regarding income, 38.2% of respondents reported earning between 20–25 million VND per month, and 35.6% reported earning above 25 million VND per month. Meanwhile, 21.4% had monthly earnings from 15–20 million VND, and only 4.8% earned below 15 million VND. These figures indicate a relatively stable and competitive income level for SME managers, reflecting both their professional status and the economic performance of SMEs in key industrial regions. The income distribution also suggests that most respondents are financially capable and likely have a strong commitment to business development and innovation initiatives.

Type of enterprise: In terms of business ownership, 33.3% of respondents represented one-member limited liability companies, followed by private enterprises (29%), joint-stock companies (20.5%), and limited liability companies with two or more members (17.2%). This composition reflects the structural diversity of Vietnam's SME sector, with a dominance of small-scale, family-run, or privately owned businesses. The prevalence of limited liability companies demonstrates the growing trend toward formalization and professionalization of business operations, aligning with government policies promoting SME development. Operating Time: Firms' operating times also varied considerably. The most significant proportion (40%) had been in operation for 10–15 years, followed by 33.2% operating for over 15 years. Meanwhile, 21% had operated for 5–10 years, and only 5.9% had operated for less than 5 years. The discussion of marital status and income levels requires deeper theoretical integration to clarify their relevance to the study's constructs. Rather than serving a descriptive purpose solely, these characteristics can inform how managers perceive and use intangible resources within their firms. For example, income level may act as a proxy for managerial seniority, autonomy, or exposure to strategic decision-making, all of which influence the ability to cultivate human capital, strengthen organizational culture, or build external relationships. Similarly, marital status often correlates with

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age, stability, and work–life balance, and may affect managerial attitudes toward innovation, risk-taking, and long-term strategic orientation. Although these variables are not directly modeled, acknowledging their potential influence helps contextualize the sample and provides insight into how personal background factors may shape managerial engagement with intangible resources and creative innovation. Integrating this perspective enhances the interpretive value of the demographic profile and aligns it more closely with the study's theoretical framework. Table 1 presents the results of reliability and convergent validity testing for all constructs in the research model. The Cronbach's Alpha values range from 0.963 to 0.986, all exceeding the recommended threshold of 0.70 (Hair et al., 2019), indicating excellent internal consistency among the measurement items.

Table 1. Testing of Cronbach's alpha, composite reliability, and average variance extracted

Factors	Code	Items	Mean	Std. Deviation	Cronbach's alpha	Composite reliability	Average variance extracted
1. Human Capital	HC	4	3.321	0.917	0.966	0.967	0.909
2. Structural Capital	SC	4	3.251	0.931	0.967	0.968	0.911
3. Relationship Capital	RC	5	3.451	0.976	0.974	0.974	0.905
4. Organizational Culture	OC	4	3.151	0.954	0.966	0.966	0.907
5. Brand Image	BI	4	3.511	0.976	0.971	0.971	0.919
6. Intangible Resources	IR	4	3.471	0.934	0.963	0.963	0.901
7. Creative Innovation	CI	4	3.381	0.955	0.983	0.984	0.953
8. Business Performance	BP	4	3.285	0.968	0.986	0.986	0.958

Similarly, the Composite Reliability (CR) values range from 0.973 to 0.989, confirming the robustness and reliability of each construct. All Average Variance Extracted (AVE) values exceed 0.90, well above the minimum requirement of 0.50, indicating strong convergent validity. Although brand image and organizational culture are conceptually multidimensional, each construct was measured with only four items, which may not fully capture their richness. The selected indicators emphasize the most theoretically central attributes but necessarily simplify broader conceptual domains. Future studies should either expand the scale's depth or employ facet-specific subscales to reflect the constructs' multidimensionality better and improve measurement precision. The exceptionally high factor loadings observed for several components of intangible resources (often exceeding 0.96) warrant additional consideration when assessing measurement validity.

Although such high values demonstrate strong convergent validity, they may also indicate potential multicollinearity or overfitting within the measurement model, especially in higher-order constructs that capture closely related subdimensions. This pattern suggests that components such as organizational culture and relationship capital may share overlapping variance, potentially inflating reliability indices and structural estimates. While the results satisfy the Fornell–Larcker and composite reliability criteria, these indicators alone may not entirely rule out redundancy among constructs. Future research should incorporate additional diagnostics, such as variance inflation factors or heterotrait–monotrait ratios, to more rigorously evaluate construct distinctiveness. Acknowledging this limitation enhances transparency and provides a more balanced assessment of the measurement model's robustness. Table 2 presents the results of the structural model analysis testing the hypothesized relationships among intangible resources (IR), creative innovation (CI), and business performance (BP).

Table 2. Intangible resources affecting business performance

Factors	Original sample	Sample mean	Standard deviation	T statistics	P values
CI → BP	0.281	0.284	0.044	6.392	0.000
IR → BI	0.967	0.967	0.003	377.611	0.000
IR → BP	0.717	0.714	0.043	16.787	0.000
IR → CI	0.824	0.824	0.021	39.446	0.000
IR → HC	0.966	0.966	0.003	371.058	0.000

IR → OC	0.971	0.971	0.002	470.959	0.000
IR → RC	0.972	0.972	0.002	514.568	0.000
IR → SC	0.970	0.970	0.002	407.040	0.000
OT x IR → BP	0.029	0.028	0.011	2.673	0.008

Note: *** with 1%.

All path coefficients (β) are positive and statistically significant at the $p < 0.01$ level, confirming strong relationships among the constructs. Specifically, IR has a direct and substantial impact on BP (β = 0.717, t = 16.787, $p < 0.001$), indicating that firms with well-developed intangible resources achieve higher performance. Furthermore, IR strongly influences CI (β = 0.824) and its subdimensions, such as HC, SC, RC, OC, and BI, with coefficients exceeding 0.96, highlighting that intangible assets serve as the foundation for human, structural, relational, and cultural development within firms.

The relationship CI → BP (β = 0.281, t = 6.392, $p < 0.001$) demonstrates that creative innovation acts as a mediating mechanism linking intangible resources to performance. Additionally, the interaction term OT × IR → BP (β = 0.029, t = 2.673, p = 0.008) confirms a moderating effect of operating time, implying that older firms can leverage intangible resources more effectively to improve outcomes. Finally, these findings validate all nine hypotheses (H1–H9), confirming that intangible resources play a pivotal role in enhancing both innovation capacity and business performance among Vietnamese SMEs.

Figure 2 illustrates the Partial Least Squares Structural Equation Modeling (PLS-SEM) results for the relationships among Intangible Resources (IR), Creative Innovation (CI), and Business Performance (BP), with Operating Time (OT) as a moderating variable. The values shown on the arrows represent the path coefficients (β) and their p-values in parentheses, while the blue circles denote the R^2 values for each endogenous construct.

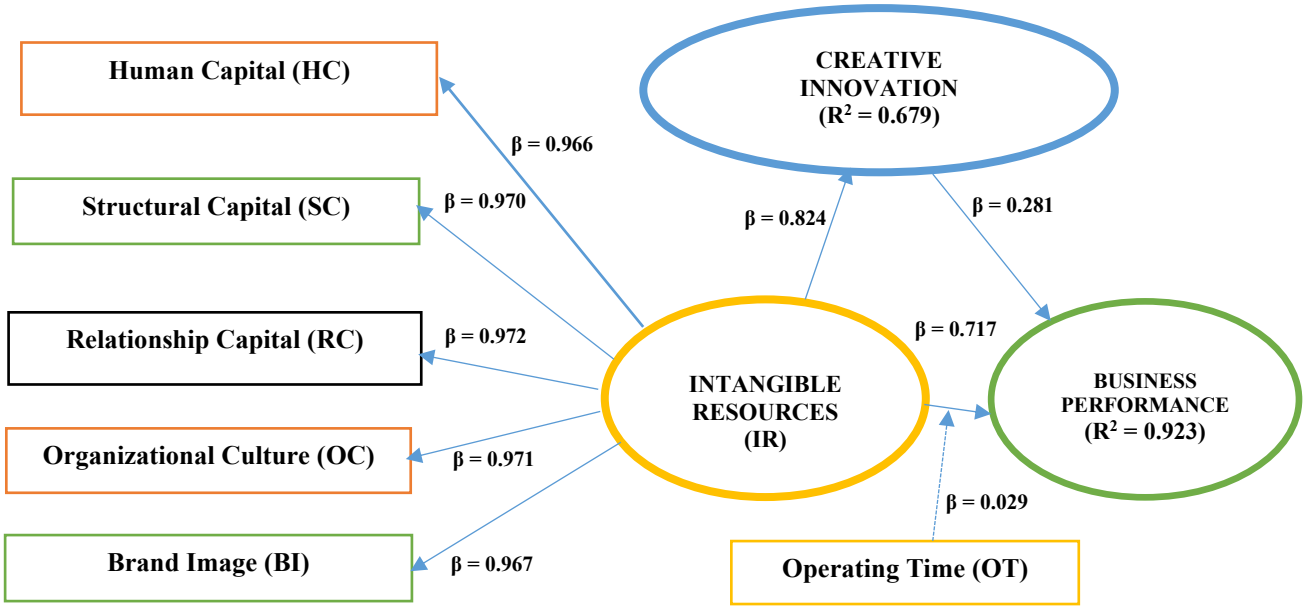

Figure 2. Testing results for intangible resources affecting business performance

The model demonstrates strong explanatory power, with $R^2 = 0.923$ for BP and $R^2 = 0.679$ for CI, indicating that the independent variables explain 92.3% and 67.9% of the variance in these constructs. All hypothesized paths are positive and statistically significant at $p < 0.01$. The relationships IR → BP (β = 0.717) and IR → CI (β = 0.824) are powerful, highlighting the pivotal role of intangible resources in driving innovation and performance. Moreover, CI → BP (β = 0.281) confirms that creative innovation mediates the effect of intangible resources on business performance. The moderating effect of OT × IR → BP (β = 0.029, p = 0.008) indicates that firms with longer operating histories can leverage intangible resources more effectively to enhance performance. Overall, the structural model exhibits excellent

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fit and high predictive validity, affirming that intangible resources serve as the strategic foundation for innovation-driven growth among Vietnamese SMEs.

4.2. Result Discussion

The empirical findings of this study provide comprehensive insights into how intangible resources (IR) influence creative innovation (CI) and business performance (BP) among small and medium-sized enterprises (SMEs) in Vietnam. The results of the PLS-SEM analysis confirm that all hypothesized relationships (H1–H9) are statistically significant, supporting the proposed conceptual model grounded in the Resource-Based View (RBV) and the Intellectual Capital Theory (ICT). These findings not only advance theory but also offer practical implications for enhancing SME competitiveness in a rapidly evolving market environment.

(1) Intangible resources as the foundation of competitive advantage: The analysis revealed that intangible resources significantly and positively influence all five subdimensions, such as Human Capital (HC), Structural Capital (SC), Relationship Capital (RC), Organizational Culture (OC), and Brand Image (BI), with path coefficients ranging from 0.966 to 0.972. These results validate the multidimensional nature of intangible resources and reinforce their central role in building sustainable competitive advantage [15], [29], [41]. This finding aligns with the RBV proposition that valuable, rare, inimitable, and non-substitutable resources underpin organizational success. Vietnamese SMEs that invest in employee competence, knowledge systems, and relational networks are better equipped to respond to environmental changes and seize emerging opportunities. The high coefficients (above 0.96) suggest that SMEs have begun to internalize intangible assets as strategic resources rather than merely operational inputs. Moreover, the results echo studies, emphasizing that intellectual capital and intangible assets form the "hidden wealth" of organizations. In emerging economies like Vietnam, where tangible resources may be limited, intangible assets such as skills, trust, and reputation become critical sources of differentiation and long-term growth.

(2) The Direct Effect of Intangible Resources on Business Performance: The relationship IR → BP ($\beta = 0.717$, $t = 16.787$, $p < 0.001$) is among the strongest in the model, indicating that firms with well-developed intangible resources achieve significantly higher levels of business performance. This confirms H6, supporting the view that intangible assets directly translate into both financial and non-financial outcomes [17], [31], [42]. This finding is consistent with previous research showing that firms leveraging intangible resources, such as employee knowledge, structural efficiency, and customer relationships, demonstrate superior productivity, profitability, and innovation capability. In the context of Vietnamese SMEs, where resource scarcity is common, intangible resources serve as strategic levers to compensate for limited capital and technology. The mean scores for IR-related variables (ranging from 3.15 to 3.51) indicate that respondents generally perceive their firms as moderately strong in intangible resource management. However, there remains room for improvement in areas such as knowledge-sharing culture, process standardization, and brand differentiation. Strengthening these aspects can enhance both internal efficiency and external competitiveness.

(3) The Mediating Role of Creative Innovation: The study also finds a significant positive relationship between Intangible Resources and Creative Innovation (IR → CI: $\beta = 0.824$, $p < 0.001$) and between Creative Innovation and Business Performance (CI → BP: $\beta = 0.281$, $p < 0.001$), confirming H7 and H8. These results suggest that creative innovation acts as a partial mediator, translating intangible resources into measurable business success [18], [33], [43]. This supports the argument that mere possession of intangible resources is insufficient; organizations must effectively mobilize them to generate innovation. Firms with more substantial human and structural capital are better able to foster creativity, knowledge exchange, and experimentation. This aligns with the Knowledge-Based View (KBV), which regards innovation as the outcome of effective knowledge integration and utilization. For Vietnamese SMEs, innovation-driven growth is vital in navigating the challenges of globalization and digital transformation. However, innovation capability depends heavily on the development of intangible resources such as leadership support, learning culture, and relationship networks. The significant path from CI to BP underscores the importance of fostering a creative environment that encourages new ideas and systematically implements them to improve operational and financial outcomes. Although creative innovation is theoretically positioned as a mechanism through which intangible resources influence business performance, the results indicate that it functions as a partial rather than a full mediator. This conclusion is supported by the finding that the direct path from intangible resources to business performance

remains statistically significant even after accounting for creative innovation. This suggests that intangible resources contribute to performance not only by stimulating idea generation and implementation but also through additional channels, such as strengthening customer relationships, enhancing organizational culture, improving brand credibility, and enabling more efficient internal structures, which exert direct effects independent of innovation activities. A full mediating role would require the direct impact to become insignificant once the mediator is included, which is not the case in this model. Therefore, treating creative innovation as a partial mediator more accurately reflects the multifaceted ways in which intangible resources shape organizational outcomes.

(4) The Moderating Role of Operating Time: Another noteworthy finding is the moderating effect of Operating Time (OT) on the relationship between Intangible Resources and Business Performance (OT × IR → BP: $\beta = 0.029$, $p = 0.008$), confirming H9. Although the effect size is modest, it is statistically significant, indicating that firms with longer operational histories are better at leveraging intangible resources to achieve performance outcomes [23], [35], [44], [45], [46]. This result supports the organizational learning theory, which suggests that experience and accumulated knowledge enhance a firm's absorptive capacity, the ability to acquire, assimilate, and apply new knowledge. Over time, firms develop a deeper understanding of market dynamics, customer preferences, and internal processes, enabling them to translate intangible resources into more effective strategic actions. Older firms are likely to have more established management systems, communication networks, and corporate cultures that support innovation and performance. Conversely, younger firms may lack the routines or experience to fully capitalize on their intangible resources.

Therefore, operational maturity acts as a catalyst that strengthens the resource–performance link, highlighting the temporal dimension of capability development in SMEs. Although the moderating effect of Operating Time is statistically significant, its small effect size ($\beta = 0.029$) warrants a more cautious interpretation. The results suggest that, while firms with longer operational histories may be somewhat better positioned to leverage intangible resources, the practical magnitude of this influence is minimal. This indicates that accumulated experience alone does not substantially strengthen the resource–performance relationship. Instead, other factors, such as managerial capability, technological readiness, market dynamism, or the firm's learning orientation, may play a more decisive role in shaping how intangible resources translate into performance outcomes. The modest effect size also suggests that longevity does not automatically enhance a firm's ability to exploit intangible assets; younger firms may compensate by being more agile, focusing on innovation, or adapting more quickly to environmental change. Recognizing this nuance prevents overstating the moderating effect and supports a more balanced understanding of its theoretical and practical implications. The model assumes linear, additive relationships, which may oversimplify how intangible resources operate in practice. Potential non-linear patterns, such as diminishing returns or threshold effects, and additional interactions among resource dimensions were not examined. Considering such effects in future research would provide a more nuanced understanding of how intangible resources jointly influence innovation and business performance.

Finally, the results confirm that intangible resources are the cornerstone of innovation and performance in Vietnamese SMEs. They not only have a substantial direct impact on business performance but also exert indirect effects through creative innovation. The moderating influence of operating time highlights the importance of organizational experience and learning in optimizing resource utilization. Collectively, these findings contribute to a deeper understanding of how SMEs in emerging economies can transform intangible assets into tangible competitive advantages in the knowledge-based era. Although the model demonstrates strong statistical relationships, potential endogeneity issues may affect the validity of the presumed causal direction from intangible resources to business performance. Reverse causality is a key concern, as firms with higher performance may have greater capacity to invest in human capital, organizational culture, or relationship development, creating a bidirectional relationship rather than a purely causal one. Omitted variables, such as leadership quality, risk orientation, or technological readiness, may also simultaneously influence both intangible resources and performance, leading to biased estimates. Furthermore, the use of self-reported cross-sectional data increases the risk of measurement error, which can exacerbate endogeneity. While Partial Least Squares Structural Equation Modeling offers predictive advantages, it does not inherently resolve these issues. Future studies should consider longitudinal data, instrumental variable techniques, or advanced PLS-based endogeneity tests to strengthen causal inference and improve the robustness of conclusions.

5. Conclusions and Policy Recommendations

5.1. Conclusions

This study examined the impact of intangible resources (IR) on business performance (BP) among small and medium-sized enterprises (SMEs) in Vietnam, using an applied data science and Structural Equation Modeling (SEM) approach. Based on the Resource-Based View (RBV) and Intellectual Capital Theory (ICT), the research conceptualized intangible resources as a multidimensional construct comprising human capital (HC), structural capital (SC), relationship capital (RC), organizational culture (OC), and brand image (BI). In addition, creative innovation (CI) was introduced as a mediating variable and operating time (OT) as a moderating factor. The analysis of 663 valid responses revealed that intangible resources significantly and positively influence both creative innovation and business performance. Among the subdimensions, relationship capital and organizational culture exhibited the highest factor loadings, indicating their critical roles in shaping firm competitiveness. Creative innovation was confirmed as a partial mediator, transforming intangible resources into measurable performance outcomes. Moreover, operating time strengthened the positive relationship between intangible resources and business performance, suggesting that firms with longer operational histories are better equipped to exploit their intangible assets effectively. Finally, the study demonstrates that intangible resources serve as the strategic foundation for sustainable performance in SMEs. The results confirm that firms leveraging knowledge, human talent, organizational systems, and brand reputation achieve superior financial and non-financial outcomes. The model not only validates the theoretical assumptions of the RBV and ICT but also provides empirical evidence supporting the importance of managing intangible assets in developing economies. Hence, enhancing intangible resources is essential for Vietnamese SMEs to foster innovation, strengthen competitiveness, and achieve long-term growth in the increasingly knowledge-driven global market.

5.2. Policy Recommendations

Based on the empirical findings and standardized Beta coefficients obtained from the structural model, this section proposes specific policy recommendations for SME managers, policymakers, and supporting institutions to strengthen the role of intangible resources (IR) in enhancing business performance (BP) through creative innovation (CI). The recommendations are organized according to the magnitude of each factor's influence, as reflected in the structural model results (table 2 and figure 2).

(1) Strengthening relationship capital (β = 0.972): Relationship capital (RC) demonstrated the highest standardized coefficient among all subdimensions of intangible resources, underscoring its pivotal role in business success. For Vietnamese SMEs, whose financial and technological resources are often limited, strong, trust-based networks with customers, suppliers, partners, and institutions provide an invaluable competitive advantage. Policy and managerial recommendations: Building long-term customer relationships: Firms should invest in customer relationship management (CRM) systems to collect, analyze, and utilize customer data effectively. A focus on customer satisfaction, after-sales service, and loyalty programs can strengthen brand credibility and ensure repeat business. Developing supplier and partner networks: Collaboration with suppliers and distributors through information sharing and joint planning enhances operational efficiency and market responsiveness. Public–private partnerships (PPPs) and cluster-based cooperation should be encouraged. Government support: Policymakers should promote SME networking platforms, such as industry associations, business incubators, and innovation hubs, to facilitate information exchange and partnership opportunities. Internationalization programs: State agencies can design export promotion programs and cross-border training to help SMEs expand relationship capital globally.

(2) Fostering organizational culture (β = 0.971): Organizational culture (OC) was found to be another critical factor influencing intangible resource development. A positive, innovative, and learning-oriented culture creates the internal environment that enables employees to share ideas, embrace change, and pursue creativity, factors essential to innovation-driven performance. Policy and managerial recommendations: SME leaders should encourage experimentation, risk-taking, and tolerance for failure. Establishing innovation awards or recognition programs motivates employees to contribute new ideas. Open and transparent communication channels, combined with participatory decision-making, foster trust and commitment among employees. Leadership should emphasize shared values such as integrity, collaboration, and continuous learning. These values can be integrated into recruitment, training, and evaluation processes. Government programs could include leadership development and change

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management training for SME owners to strengthen innovation culture and strategic vision. A strong culture acts as the "social glue" that aligns individual efforts with organizational goals, ensuring that intangible assets are used efficiently to drive performance and innovation.

(3) Enhancing structural capital (β = 0.970): Structural capital (SC) represents organizational systems, processes, databases, and technological infrastructure that enable employees to perform effectively. High SC coefficients indicate that well-structured systems amplify the impact of human and relationship capital on innovation and performance. Policy and managerial recommendations: SMEs should adopt digital management tools such as Enterprise Resource Planning (ERP) systems, data analytics platforms, and cloud-based collaboration software to improve efficiency and coordination. Documenting operational procedures and implementing quality management systems helps preserve organizational knowledge and ensure consistency. Establishing internal knowledge repositories allows for the storage and dissemination of valuable know-how, reducing dependence on individual employees. Policymakers should provide tax incentives or grants to SMEs that adopt digital technologies and management systems supporting structural capital formation. Strengthening structural capital enhances organizational resilience and enables SMEs to adapt quickly to market changes, leading to sustainable innovation and performance improvements.

(4) Promoting human capital development (β = 0.966): Human capital (HC) was also strongly influenced by intangible resources, underscoring the importance of employees as the key drivers of innovation and performance. In a knowledge-based economy, a skilled and motivated workforce represents the most valuable organizational asset. Policy and managerial recommendations: SMEs should prioritize capacity-building programs focusing on technical expertise, leadership, and digital skills. Regular training helps employees stay competitive and fosters an innovative mindset. Competitive compensation, recognition systems, and career advancement opportunities can enhance employee satisfaction and loyalty. Creating internal learning communities, mentorship programs, and cross-functional teams can stimulate creativity and collaboration. Policies should incentivize SMEs to invest in employee training through subsidies, vocational education partnerships, and public training centers. Cooperation between universities and SMEs should be encouraged to bridge skill gaps. Investing in human capital not only strengthens innovation capacity but also builds a foundation for organizational learning and adaptability.

(5) Enhancing brand image (β = 0.967): Brand image (BI) plays a crucial role in establishing external legitimacy and customer trust. A strong brand represents accumulated intangible value, reflecting quality, reliability, and reputation, all of which drive customer loyalty and competitive differentiation. Policy and managerial recommendations: SMEs should develop unified branding strategies that communicate their values, quality, and social responsibility. Effective use of digital marketing and social media can enhance visibility and engagement. Maintaining consistent service quality and responsive communication builds a positive brand perception. SMEs can improve their reputations by engaging in community development and sustainable practices, which are increasingly influencing consumer choices. Establishing "Vietnam SME Brand Excellence" recognition programs or funding branding consultancy services can help SMEs enhance brand management capabilities. Brand image, when aligned with relationship capital and organizational culture, strengthens market positioning and contributes to long-term business success.

(6) Stimulating creative innovation (IR → CI: β = 0.824; CI → BP: β = 0.281): The model confirms that creative innovation (CI) mediates the relationship between intangible resources and business performance. Firms with stronger IR bases exhibit higher innovation capacity, which in turn boosts performance outcomes. Policy and managerial recommendations: Government agencies should support SME innovation through technology parks, incubators, and funding for RandD collaboration with universities. Linking SMEs with research institutions and startups enhances access to technology and innovative solutions. Policies promoting venture capital, innovation grants, and tax deductions for RandD investments will enable SMEs to innovate more aggressively. Firms should establish innovation units or teams responsible for idea screening, prototype development, and commercialization. By integrating innovation into daily operations, SMEs can transform intangible resources into tangible market advantages and higher productivity.

(7) Leveraging operating time as a strategic advantage (OT × IR → BP: β = 0.029): Although the moderating effect of Operating Time (OT) is relatively small, it is statistically significant, indicating that older firms are more capable of exploiting intangible resources for business performance. This underscores the value of accumulated experience, organizational learning, and process maturity. Policy and managerial recommendations: Government agencies can

establish mentorship programs that pair experienced SMEs with newer enterprises to help them develop intangible assets and innovation capabilities. Creating national databases or online learning portals for SME best practices will allow firms to learn from long-established peers. Tailored support should be designed for SMEs at different life stages, e.g., training and innovation support for young firms, export facilitation for mature firms. Older firms should formalize their accumulated experience through documentation, mentoring, and digital archiving systems to sustain performance.

Despite its valuable contributions, this study has several limitations that warrant consideration. First, the research focuses exclusively on SMEs in Dong Nai and Ho Chi Minh City, which may limit the generalizability of findings to other regions or larger enterprises in Vietnam. Future studies should expand the sample to include firms from diverse industries and other provinces to ensure broader applicability. Second, the data were collected through cross-sectional surveys, which capture relationships at a single point in time. Longitudinal studies could provide deeper insights into how intangible resources and innovation capabilities evolve. Third, this study primarily relies on self-reported measures, which may introduce subjective bias. Future research could integrate objective performance indicators or secondary data to strengthen validity. Finally, comparative studies across ASEAN economies or sectors could help identify contextual factors that influence the role of intangible resources in driving SME performance and innovation. Future research should incorporate sector-based subgroup analyses or multi-group SEM to determine whether the IR → CI pathway operates differently across manufacturing, services, and trade-oriented SMEs.

6. Declarat1ions

6.1. Author Contributions

Conceptualization: L.D.H. and P.T.T.; Methodology: P.T.T.; Software: L.D.H.; Validation: L.D.H. and P.T.T.; Formal Analysis: L.D.H. and P.T.T.; Investigation: L.D.H.; Resources: P.T.T.; Data Curation: P.T.T.; Writing Original Draft Preparation: L.D.H. and P.T.T.; Writing Review and Editing: L.D.H. and P.T.T.; Visualization: L.D.H.; All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

6.3. Funding

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6.4. Institutional Review Board Statement

Not applicable.

6.5. Informed Consent Statement

Not applicable.

6.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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