International Journal of Management and Sustainability
2025 Vol. 14, No. 4, pp. 1203-1218
ISSN(e): 2306-0662
ISSN(p): 2306-9856
DOI: 10.18488/11.v14i4.4645

Technological innovation and SME performance: Mediating roles of digital transformation & resource integration, moderating roles of strategic orientation & market dynamics

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Article History
Received: 30 July 2025
Revised: 25 September 2025
Accepted: 5 December 2025
Published: 31 December 2025

Keywords
Digital transformation
Market dynamics
SME performance
Strategic orientation
Technological innovation.

ABSTRACT

This study aims to investigate the impact of technological innovation (TI) on the performance of small and medium-sized enterprises (SMEs), while exploring the mediating roles of digital transformation (DT) and resource integration (RI), and the moderating effects of strategic orientation (SO) and market dynamics (MD). A quantitative research design was adopted using a structured questionnaire distributed to employees working in various Chinese companies. The population consisted of full-time employees across diverse industries in urban China. A sample of 412 respondents was selected using stratified random sampling to ensure representation across sectors. A structured questionnaire was administered to key managerial respondents, and the data were analyzed using SmartPLS structural equation modeling (SEM). Measurement scales were adapted from established studies to ensure validity and reliability of constructs. The results confirmed that TI has a significant positive impact on SME performance. Additionally, DT and RI were found to mediate this relationship effectively. The moderating analyses revealed that SO and MD significantly strengthen the positive effect of TI on performance, underscoring the importance of internal strategic alignment and responsiveness to external environments. This study advances the literature by integrating Resource-Based View (RBV) and Dynamic Capabilities Theory (DCT) to explain how SMEs can leverage innovation for superior outcomes. Beyond theoretical contributions, the findings provide practical guidance for SME managers and policymakers on embedding innovation strategies, fostering digital transformation, and aligning resources to enhance sustainability and long-term growth in volatile markets.

Contribution/Originality: This study contributes by demonstrating how technological innovation, supported by strategic orientation and market adaptability, drives SME performance in China. By applying SmartPLS structural equation modeling, it extends theoretical understanding through RBV and dynamic capabilities, while offering practical insights to enhance SME competitiveness and long-term sustainability.

1. INTRODUCTION

With the global economy, Small and Medium-sized Enterprises (SMEs) are also referred to as significant drivers of employment creation, economic diversification, and technology-led development. Particularly in emerging and developing economies, SMEs dominate the majority of enterprises and play a vital role in improving national productivity and technological development (Abdullah, Taliang, Efendi, Kasmi, & Aman, 2024). These firms, however, are faced with many challenges in ensuring competitiveness since they have limited financial, human, and infrastructural resources (Anim, Arthur, & Amoako, 2024). In the face of heightened market uncertainty and digital

disruptions, technology innovation has emerged as a powerful transformative force that supports SMEs in overcoming structural constraints, promoting operational efficiency, and exploiting new growth opportunities (Amoa-Gyarteng, Dhliwayo, & Adekomaya, 2024). The rapid adoption of digital technologies, such as cloud computing, artificial intelligence, big data, and mobile platforms, has enabled SMEs to restructure their business models, automate processes, and engage with customers more effectively (Fang & Liu, 2024).

Prior empirical studies have widely documented the favorable effect of TI on enterprise performance, particularly in the context of SMEs (Parker, Schoar, & Sun, 2023). Various studies have found that innovation allows companies to produce differentiated products, reduce production expenses, respond quickly to customers' needs, and penetrate new markets (Javed, Nawaz, & Javed, 2023). For example, SMEs that make R&D investments, implement new production technologies, and use digital platforms have recorded greater profitability, customer satisfaction, and market share compared to non-innovative firms (Islami & Mulolli, 2024). Empirical research further shows that TI facilitates strategic flexibility, which enables SMEs to respond rapidly to fluctuations in environmental conditions (Kgakatsi, Galeboe, Molelekwa, & Thango, 2024). Technology adoption typically has to be accompanied by changes in organisational capabilities, knowledge structures, and cultural attitudes (Ahmad, Youjin, Žiković, & Belyaeva, 2023). Thus, the connection between innovation and performance is moderated by a firm's capacity to effect digital transformation (DT) and its effectiveness in exploiting internal and external resources (Chwiłkowska-Kubala, Cyfert, Malewska, Mierzejewska, & Szumowski, 2023). Additional empirical research has investigated the contextual and organizational moderators of the strength and direction of the innovation–performance relationship (Ijiga et al., 2024). Many studies have also referred to the mediating function of DT (Plekhanov, Franke, & Netland, 2023). Butt, Imran, Helo, and Kantola (2024) posited that DT allows SMEs to integrate their technology investments into strategic goals, thus converting TI into performance results.

Despite the increasing volume of empirical research, numerous gaps persist in understanding how TI enhances SME performance (Kumar, Rani, Rani, & Rani, 2024). Second, much previous work has viewed the innovation–performance nexus as linear and direct, without critically examining the mediating processes by which innovation is realized in concrete performance outcomes (Li, Su, Ding, Tian, & Wu, 2024). Specifically, the mediating roles of DT and RI remain underexamined in emerging markets, whose digital infrastructure and innovation capacity are still evolving (Wang & Zhang, 2025). Additionally, there is limited knowledge on how contextual moderators, such as SO and MD, influence the impact of TI (Cannavacciuolo, Ferraro, Ponsiglione, Primario, & Quinto, 2023). Although some research has analyzed these variables independently, few have probed their interactional effects in an integrated model (Fang & Liu, 2024). Strategic direction, such as proactive and customer-oriented strategies, is essential for channeling the application of innovative technologies in value creation; however, in its role as a moderator of the current state, it remains under-tested in the empirical environment (Ijiga et al., 2024). Market dynamism may either reinforce or constrain the results of innovation, depending on the responsiveness and adaptability of SMEs to environmental changes (Parker et al., 2023). This research aims to overcome these limitations by proposing a moderated mediation model that incorporates both internal and external moderators, thereby providing a more comprehensive understanding of the innovation–performance relationship in SMEs.

The primary aim of this study is to examine how TI affects SME performance through mediating and moderating variables. More specifically, the research seeks to (1) investigate the direct influence of TI on SME performance, (2) discuss the mediating effects of DT and RI on the relationship, and (3) determine the moderating influence of SO and MD on the link between innovation and performance.

This research is of particular academic and applied importance to innovation management and the development of SMEs. Academically, it develops knowledge on how dynamic capability and SO interact with TI to enhance firm performance, particularly within under-studied emerging economies. It further makes theoretical contributions to the integration of the RBV and DCT through empirical testing of the mediating and moderating processes involved. In practice, the research provides SME managers with a strategic blueprint for leveraging TI in DT and resource

allocation. It underscores the need to develop a well-defined strategic direction and remain sensitive to MD to maximize returns from investments in innovation. For policymakers, the findings can inform support programs aimed at enhancing SME innovation capabilities, infrastructure readiness, and ecosystem development, ultimately contributing to national economic resilience and technological advancement.

2. LITERATURE REVIEW

2.1. TI and SME Performance

TI, broadly defined as the application of new or radically improved products, processes, or practices, has been widely recognized as a key determinant of firm-level competitiveness and expansion (Ahmad et al., 2023). TI in manufacturing SMEs refers to the capacity of these enterprises to innovate and apply digital technologies, automation technologies, data analytics, and product development technologies, among others, to enhance processes, reduce costs, and increase value delivery (Zou, 2024). SME performance, however, is generally assessed by employing both financial metrics (such as profitability and sales growth) and non-financial metrics (such as customer satisfaction and market growth) that indicate the company's success in meeting strategic goals (Zhuo & Chen, 2023). The application of new technology allows SMEs to react better to changing markets, provide more tailored products, and become more productive, all of which have a direct impact on enhanced performance outcomes (Zhang, Gao, & Zhou, 2023). Empirical evidence confirms that TI is one of the most important determinants of SME performance (Wang & Zhang, 2025; Zou, 2024). For example, research has found that product- and process-innovative SMEs outperform non-innovative companies in market share, revenue growth, and customer retention (Zhang et al., 2023). Moreover, digital innovation has been correlated with better supply chain management and customer relationship effectiveness, both of which have been correlated with superior operational and financial performance (Singun, 2025). Further evidence indicates that companies with strategic investment in technology development will continue to face competitive pressures and, hence, continue with their growth (Muhammad, Dey, Kamal, Samuel, & Alzeiby, 2025).

H_1: TI has a significant positive effect on SME performance.

2.2. DT as Mediator

DT is defined as the end-to-end adoption and integration of digital technologies across all functions of a firm, transforming the fundamental way firms conduct business and create value for customers (Singun, 2025). It is not just about upgrading the toolset, but also about transforming business models, organizational culture, and processes to become more adaptive, data-driven, and customer-focused (Kontić & Vidicki, 2018). Although TI provides the tools and methods for progress, DT is the larger strategic and cultural shift necessary to leverage value from such innovations (Muhammad et al., 2025). In SMEs, such transformation may involve cloud computing, IoT solutions, mobile platforms, and big data analytics, enabling small businesses to access new markets, enhance service delivery, and increase productivity (Plekhanov et al., 2023). Empirical research has started examining the mediating effect of DT in the innovation–performance nexus. Prihandono, Wijaya, Wiratama, Prananta, and Widia (2024), for example, it was found that the effective adoption of TIs is positively linked to DT activities, which, in turn, contribute to enhanced organizational performance indicators. Likewise, Plekhanov et al. (2023) argue that TI, by itself, does not necessarily lead to performance improvement unless companies also undergo DT to leverage new capabilities effectively. This suggests that DT is a bridge that unites innovative capacity with performance results.

H_2: DT mediates the relationship between TI and SME performance.

2.3. RI as Mediator

RI can be defined as the firm's capacity to integrate internal and external resources, such as knowledge, technology, skills, and networks, into unified and value-generating business processes (Hendrawan, Chatra, Iman, Hidayatullah, & Suprayitno, 2024). Within the SME environment, where resources are scarce, leveraging various

resources is crucial to tap into TI successfully (Shi, Yao, Zhao, & Yan, 2024). Such reasoning accords with the service-dominant logic and the RBV, according to which competitive advantage is not only a function of being rich in valuable resources but also of an organisation's capacity to integrate and use them effectively (Aghajari & Amat Senin, 2014). TI can provide new abilities and potential, but without effective RI, SMEs are not able to implement these innovations effectively or transform them into enhanced performance (Appiah-Kubi, Boateng, Dogbe, & Kumah, 2024). Several empirical studies confirm the mediating role of RI in innovation-performance relationships (Aggrawal & Pandey, 2025; Aghajari & Amat Senin, 2014; Ahmad et al., 2023). For instance, Kgakatsi et al. (2024) demonstrated how SMEs that excel at integrating external knowledge, supplier competence, and in-house capabilities have a greater likelihood of translating technological progress into operational performance and customer satisfaction. Likewise, Muhammad et al. (2025) shows how RI maximizes a company's absorptive capacity and innovation deployment, which in turn translates into better performance.

H_3: RI mediates the relationship between TI and SME performance.

2.4. SO as Moderator

SO refers to the direction and range of an organization's strategy, that is, its market responsiveness, innovativeness, customer focus, and long-term goal congruence (Amin et al., 2023). It delineates to what degree the firm focuses on proactive conduct, risk-seeking, and resource coordination in order to take advantage of opportunities from the external environment (Handoyo, Mulyani, Ghani, & Soedarsono, 2023). A strong strategic direction in the SME context allows companies to anticipate market demand, create innovative solutions with respect to strategic objectives, and use technological progress to increase competitiveness and performance (Iqbal, Mawardi, Sanawiri, Alfisyahr, & Syarifah, 2023). Technology innovation has enormous potential, but its ability to improve performance is within the strategic context in which it is being applied (Jahanshahi, Sonmez Cakir, Adiguzel, & Karaaslan, 2025). Empirical research indicates that a SO is critical to play a role in mediating the innovation–performance relationship (Iqbal et al., 2023). For instance, Liu and Wang's (2023) Research discovers that those SMEs that possess an established SO are more capable of converting innovation into business success because of their market foresight and internal congruence. Similar to this, Xiao, Al Mamun, Masukujjaman, and Yang (2023) also proved that entrepreneurial and SOs reinforce the capabilities of a firm to engage in and capitalize on TIs.

H_4: SO has a positive moderating effect on the relationship between TI and SME performance, such that the relationship is stronger when SO is high.

2.5. MD as Moderator

MD is the pace and volatility of change in customer preferences, competitor behavior, and technology innovation in an industry (Aggrawal & Pandey, 2025). A highly dynamic market creates an environment under which companies have to keep changing and innovating in order to remain competitive and exist (Butt et al., 2024). For SMEs, which lack the financial and size resources of large companies, addressing dynamic markets through TI is a determinant of growth and survival (Essayem, Gormus, & Guven, 2023). The impact of such innovation efforts, though, varies depending on market dynamism levels. In dynamic environments, TI provides responsiveness and adaptability, with substantial influence on performance outcomes (Amoa-Gyarteng et al., 2024). There has been a consistent research call to pay greater attention to the impact of environmental factors, including market dynamism, on the innovation-performance relationship (Jahanshahi et al., 2025). Zhang et al. (2023) discovered that in dynamic markets, innovation's impact on performance is significant since there is a greater need for differentiation and responsiveness. In the same way, Lafuente, Szerb, and Rideg (2020) contended that companies in highly dynamic markets gain more strategically from innovation since it allows them to respond faster to the changing needs and activities of their competitors. The results corroborate that the relationship between TI and SME performance is stronger where there is high market dynamism.

H_5: MD positively moderates the relationship between TI and SME performance, such that the relationship is stronger under high market dynamism.

2.6. Theoretical Framework Supporting the Research

The theoretical underpinnings for explaining the interrelationships between TI, SME performance, and the mediating and moderating variables of this research are primarily based on the RBV and DCT. Based on the RBV, companies gain a competitive edge and superior performance through the purchase and efficient application of valuable, rare, inimitable, and non-substitutable (VRIN) resources (Barney, 2001). TI is conceptualized as a strategic resource with the capability to lead to improved firm performance when grounded within an organization's processes and culture. However, RBV does not fully explain the flexibility needed in rapidly changing environments. Therefore, DCT complements RBV by focusing on a firm's capacity for integrating, building, and reconfiguring internal and external competences in reaction to changing market circumstances (Teece, Pisano, & Shuen, 1997). In this regard, DT and RI serve as dynamic capabilities that mediate the impact of TI on SME performance by allowing firms to realize and scale innovative solutions. Similarly, SO and MD are boundary conditions that act to temper the strength of the innovation-performance relationship. SO provides the internal direction to guide innovation toward performance objectives, whereas MD are external environmental pressures that enhance or limit the effect of innovation. Therefore, this combined theoretical perspective offers a robust explanation for why and how TI impacts SME performance, taking into account both internal and external environments. Figure 1: The conceptual framework diagrammatically displays the assumed associations, showing TI as the independent variable, SME performance as the dependent variable, DT and RI as mediators, and SO and MD as moderators.

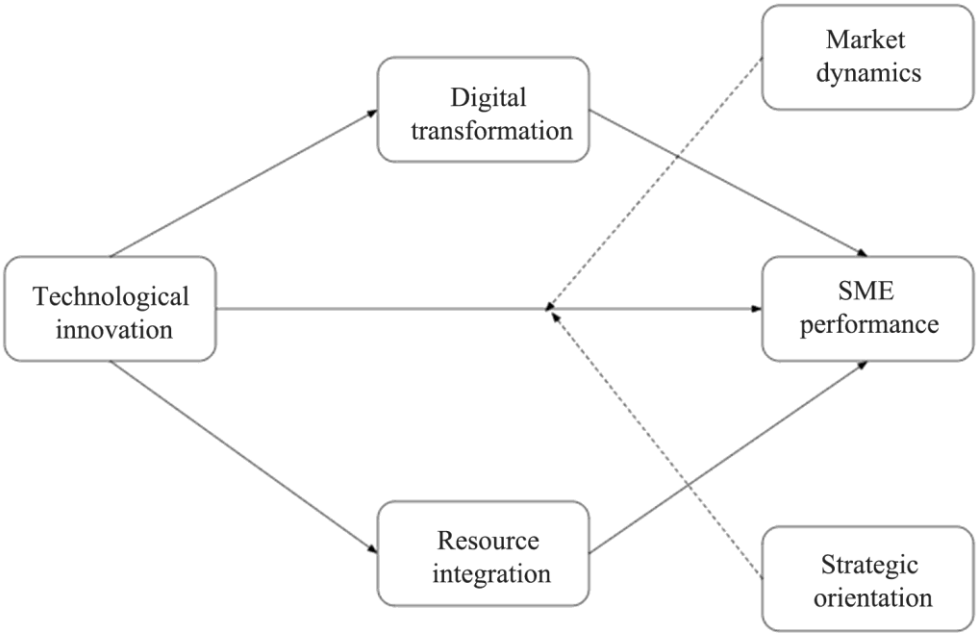

Figure 1. Conceptual framework.

3. METHODOLOGY

This research employed a quantitative cross-sectional design to investigate how TI affects SME performance through mediators (DT and RI) and moderators (MD and SO). A deductive, theory-based approach, grounded in the RBV and DCT, was adopted. SmartPLS 4.0 was chosen for structural equation modelling (SEM) because it is suitable for complex models with multiple mediators and moderators, handles non-normal data, and offers robustness with modest sample sizes. The population consisted of owners, managers, and senior decision-makers of SMEs from various industries (manufacturing, services, and technology) in urban and semi-urban business centres in China.

Companies were selected based on the Chinese official SME categorisation (e.g., having fewer than 250 employees and a yearly turnover below specified national thresholds). Respondents were individuals directly engaged in strategic decisions related to innovation and technology adoption. A minimum target sample size of 200 was established based on the "rule of ten" for SEM and power analysis using G*Power (medium effect size, power = 0.95, $\alpha = 0.05$). A total of 370 usable responses were obtained. A stratified random sampling method provided proportional representation by sectors (manufacturing, services, technology) and enterprise size groups (small vs. medium). Simple random sampling was applied within each stratum to select respondents, thereby increasing representativeness and minimising sampling bias. Data collection was achieved using a standardised questionnaire, disseminated through online media (email, business networks, and SME forums online) and on-site visits to SME associations and incubators in Chinese cities. The survey included demographic sections and all study constructs: TI, DT, RI, SO, MD, and SME performance. Five-point Likert scales (1 = strongly disagree to 5 = strongly agree) were employed. All the scales were borrowed from established earlier research such as TI (Sirilli & Evangelista, 1998), DT (Kontić & Vidicki, 2018), RI (Amoako, Huai Sheng, Dogbe, & Pomegbe, 2022), SO (Aggrawal & Pandey, 2025), MD (Lafuente et al., 2020), and SME performance (Javed et al., 2023). Pilot testing with 15 Chinese SME managers was conducted to confirm the clarity, appropriateness, and reliability of the instrument before its full implementation. The gathered data were then analyzed through SmartPLS 4 in a two-step procedure. The initial step aimed at evaluating the measurement model to determine construct validity and reliability. Reliability was tested via Cronbach's alpha and composite reliability (CR), while convergent validity was checked using factor loadings and average variance extracted (AVE). Discriminant validity was ascertained using the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio. The second step was to estimate the structural model to verify hypotheses. The most important criteria were to inspect path coefficients, R^2 estimates, effect sizes (f^2), and predictive relevance (Q^2). Bootstrapping using 5,000 subsamples was used to calculate the statistical significance of direct effects, indirect mediation effects, moderating interaction terms, and conditional indirect effects (moderated mediation). This analytical approach enabled sound testing of the conceptual model suggested while considering the predictive aims of the study.

4. RESULTS

Table 1 presents the reliability and validity measures for all primary constructs used in the study are thoroughly evaluated. All constructs demonstrate high internal consistency reliability, as evidenced by Cronbach's alpha values, all of which exceed the acceptable threshold of 0.70. The construct DT, comprising four items, exhibits high outer loadings ranging from 0.808 to 0.874, a Cronbach's alpha of 0.873, a composite reliability (CR) of 0.913, and an average variance extracted (AVE) of 0.724, thereby establishing convergent validity. The MD construct, with three measurement items, registers outer loadings between 0.825 and 0.875, a Cronbach's alpha of 0.813, CR of 0.889, and AVE of 0.727.

The reliability of RI is also marked by outer loadings above 0.862, with a Cronbach's alpha of 0.837, CR of 0.902, and AVE of 0.754. The performance of SMEs, assessed using six outer loadings, ranges from 0.768 to 0.826, with Cronbach's alpha of 0.889, CR of 0.915, and AVE of 0.643. Although the construct SO shows relatively lower item loading for SO1 at 0.697, it remains acceptable with a Cronbach's alpha of 0.773, CR of 0.855, and AVE of 0.596. The TI construct demonstrates strong measurement properties, with outer loadings exceeding 0.804, a Cronbach's alpha of 0.909, CR of 0.932, and AVE of 0.734.

Overall, all constructs satisfy the recommended criteria for construct reliability and convergent validity, confirming the robustness of the measurement model. Figure 2 illustrates the estimated structural model, showing the relationships among SS, HRMP, SE, and EE.

Table 1. Measurement model – Reliability and validity.

Variables	Items	Outer loading	Cronbach's alpha	CR	AVE
Digital transformation	DT1	0.863	0.873	0.913	0.724
	DT2	0.874			
	DT3	0.858			
	DT4	0.808			
Market dynamics	MD1	0.875	0.813	0.889	0.727
	MD2	0.857			
	MD3	0.825			
Resource integration	RI1	0.874	0.837	0.902	0.754
	RI2	0.868			
	RI3	0.862			
SME performance	SMEP1	0.808	0.889	0.915	0.643
	SMEP2	0.818			
	SMEP3	0.804			
	SMEP4	0.826			
	SMEP5	0.786			
	SMEP6	0.768			
Strategic orientation	SO1	0.697	0.773	0.855	0.596
	SO2	0.801			
	SO3	0.788			
	SO4	0.797			
Technological innovation	TI1	0.870	0.909	0.932	0.734
	TI2	0.848			
	TI3	0.886			
	TI4	0.804			
	TI5	0.872			

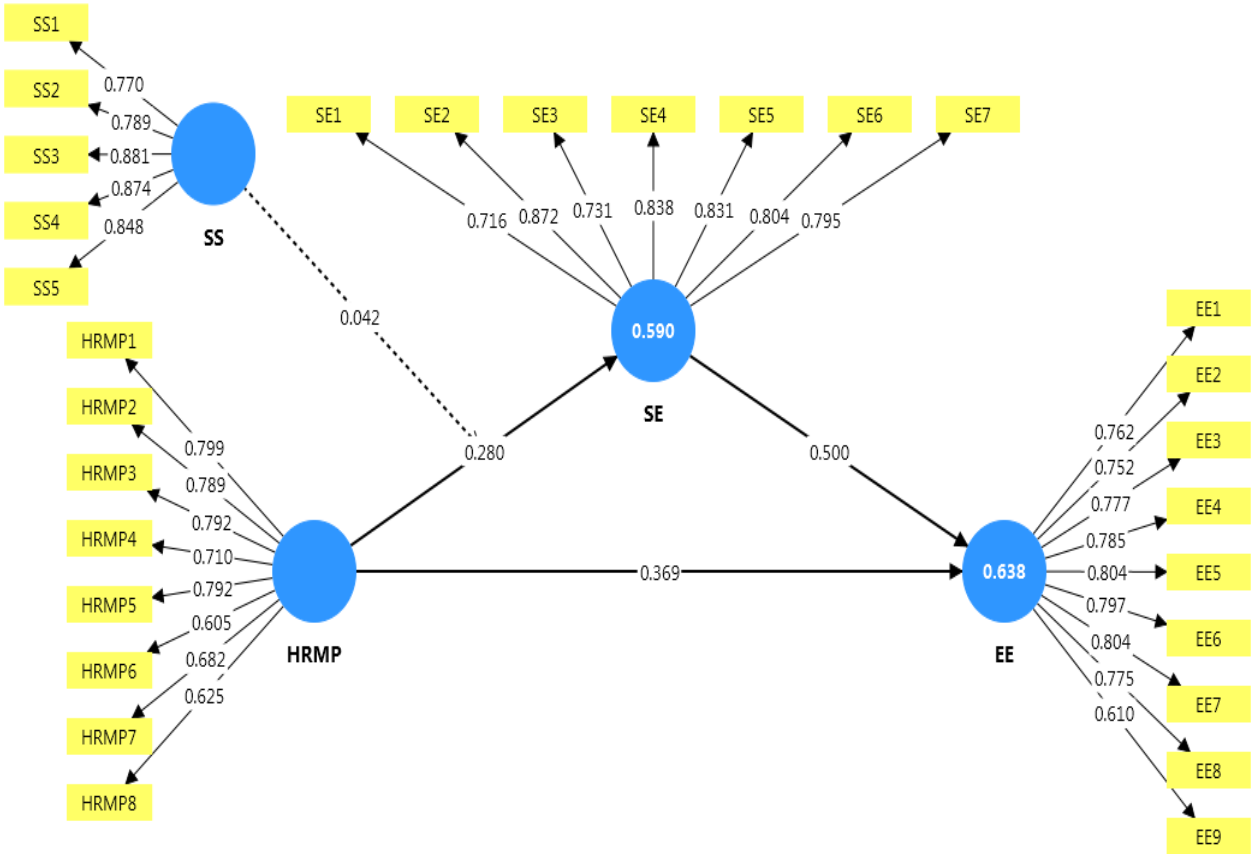

Figure 2. Estimated model.

Table 2 presents the discriminant validity outcome was tested using both the Heterotrait-Monotrait ratio (HTMT) and the Fornell-Larcker criterion. HTMT values represent the strength of the connections between latent

constructs, and a value below 0.90 is generally considered acceptable for discriminant validity. All values in this research are below the threshold, with the highest at 0.852 between TI and RI, and at 0.846 between DT and SO. These values confirm that each construct is empirically distinct from the others. For example, the HTMT value of DT to MD is 0.630, indicating a moderate correlation but discriminant separation within acceptable bounds. Likewise, TI has a value of 0.751 in relation to SME performance, again within acceptable limits.

The Fornell-Larcker criterion also establishes discriminant validity by comparing the square root of each construct's AVE (diagonal values) with correlations between constructs (off-diagonal values). For instance, the square root of AVE for DT is 0.851 and is higher than all its correlations with other constructs. Likewise, the square root of AVE for TI (0.857) is higher than its correlations with MD (0.556), RI (0.766), SME performance (0.678), and SO (0.691). This pattern is consistent across all constructs, reinforcing that the latent variables measure unique concepts without excessive overlap. Overall, both HTMT and Fornell-Larcker results provide strong support for the discriminant validity of the measurement model in this research.

Table 2. Measurement model- Discriminant validity.

HTMT						
	DT	**MD**	**RI**	**SMEP**	**SO**	**TI**
Digital transformation						
Market dynamics	0.630					
Resource integration	0.790	0.596				
SME performance	0.764	0.599	0.735			
Strategic orientation	0.846	0.830	0.835	0.817		
Technological innovation	0.815	0.644	0.852	0.751	0.821	
Fornell-Larcker criterion						
Digital transformation	0.851					
Market dynamics	0.534	0.853				
Resource integration	0.843	0.495	0.868			
SME performance	0.674	0.772	0.637	0.802		
Strategic orientation	0.693	0.657	0.670	0.766	0.772	
Technological innovation	0.852	0.556	0.766	0.678	0.691	0.857

Table 3 presents the R-square statistics and model fit statistics for the endogenous measures. DT has a value of 0.726, explaining 72.6% of the variance with its predictors, indicating strong explanatory power. RI has a value of 0.587, representing a moderately strong degree of explained variance. SME performance exhibits an R-squared value of 0.747, indicating that the model accounts for approximately 74.7% of its variance, which reflects the model's efficacy. The Q^2 values, which reflect predictive relevance, are all greater than 0.5, indicating good predictive accuracy. Furthermore, the SRMR value is 0.080, which is less than the threshold of 0.10, indicating that the global model has a good fit between the hypothesized structure and the observed data. Figure 3 presents the structural model for path analysis displays the t-values associated with the hypothesized relationships among SS, HRMP, SE, and EE.

Table 3. Structural model - R-square statistics, model goodness-of-fit statistics.

Constructs	**R-square**	**R-square adjusted**	**Q2**	**SRMR**
Digital transformation	0.726	0.726	0.723	0.080
RI	0.587	0.586	0.576	
SME performance	0.747	0.743	0.726	

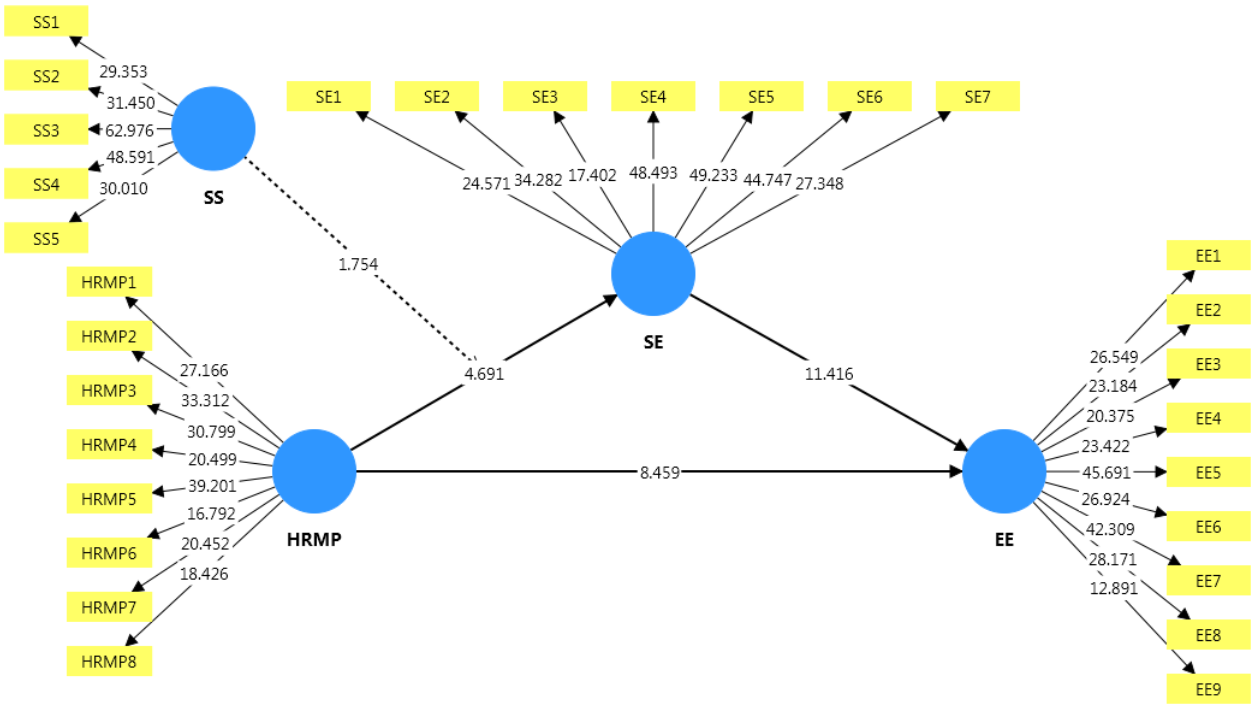

Figure 3. Structural model for path analysis.

Table 4 shows the outcome of structural path analysis and hypothesis testing. The initial hypothesis (H1), that TI has a positive impact on SME performance, is confirmed with a beta of 0.127, t-value of 3.424, and p-value of 0.001, reflecting a statistically significant association. The second hypothesis (H2), where DT is used as a mediator, yields a beta of 0.093 and a p-value of 0.079, indicating marginal mediation that borders on statistical significance. The third hypothesis (H3), which posits that the RI mediates the role, is accepted with a beta of 0.074, a t-value of 1.879, and a significant p-value of 0.030. The fourth hypothesis (H4), stating that SO moderates the relationship between TI and SME performance, is accepted at a beta of 0.075, a t-value of 1.917, and a p-value of 0.028, indicating a moderation effect. Last but not least, hypothesis five (H5), which examines MD as a moderator, is well-supported with a beta of 0.078, a t-value of 4.108, and a p-value of 0.000, highlighting the significant role of environmental dynamism in enhancing the relationship between innovation and performance.

Table 4. Structural model- Path analysis.

Hypothesis	Beta	T-value	P-value
TI -> SMEP	0.127	3.424	0.001
TI -> DT -> SMEP	0.093	1.760	0.079
TI ->RI -> SMEP	0.074	1.879	0.030
SO x TI -> SMEP	0.075	1.917	0.028
MD x TI -> SMEP	0.078	4.108	0.000

5. DISCUSSION

In today's fast-evolving business world, TI has emerged as a central driving force in enhancing the performance and competitiveness of small and medium-sized enterprises (SMEs). With global markets spurring TI, as well as increasing market competition, SMEs are increasingly compelled to innovate not only to survive but also to remain competitive in rapidly changing environments. This research contributes to this debate by empirically studying the impact of TI on SME performance, the mediating roles of DT and RI, and the moderating effects of SO and MD. Based on the RBV and DCT, the study offers an integrated view of the internal and external mechanisms underlying the link between innovation and performance. Using SmartPLS structural equation modeling and data from Chinese SMEs, the research findings provide critical insights into the strategic orchestration of innovation amid resource

scarcity and opportunity abundance. The discourse analyzes the theoretical and practical significance of the findings regarding each hypothesis, offering a nuanced understanding of how innovation is shaped by and responds to organizational capacity and environmental factors.

The research results strongly support the positive direct relationship between TI and SME performance, as proposed in H1. This verifies that TI is a strategic asset, facilitating SMEs to achieve better performance results, such as enhanced productivity, market responsiveness, and profitability. The validity of this hypothesis is consistent with the RBV, which posits that companies derive competitive advantage by acquiring and leveraging valuable, rare, inimitable, and non-substitutable resources (Barney, 2001). TI is a useful resource when integrated into firm-specific processes and leveraged efficiently to differentiate the firm from its competitors. In fast-industrialising and innovation-led economies such as China, SMEs that leverage new technologies, including AI, automation tools, and digital platforms, are well-equipped to innovate in product offerings, maximize internal operations, and increase market access. This finding also aligns with previous empirical research (Appiah-Kubi et al., 2024; Hendrawan et al., 2024; Mushi, 2024), which has shown that technologically innovative SMEs outperform their non-innovative counterparts in both financial and non-financial performance metrics. Thus, this research contributes to the emerging consensus that innovation not only benefits but is also essential for SMEs attempting to survive in competitive and dynamic business environments.

The study also confirmed the mediating role of DT between TI and SME performance, thus confirming Hypothesis H2. This indicates that, while technology innovation provides the tools, it is through DT that these tools are strategically deployed across the value chain to produce measurable outcomes. It can be understood in the light of DCT, which states that firms need not only valuable assets but also develop the ability to reconfigure, recombine, and adjust these assets to new environments (Teece et al., 1997). DT is a dynamic capability, as it means rethinking business models, automating processes, and making real-time decisions based on insights learned from data. When SMEs are able to implement DT strategies well, they maximize the force of technology innovation and become increasingly responsive to market trends and customer expectations. This finding supports (Chwiłkowska-Kubala et al., 2023; Paul et al., 2024; Wang & Zhang, 2025) who contend that DT functions as a bridge between innovation efforts and organisational performance. Most particularly in technologically sophisticated urban centers, like Shanghai, where competition in the marketplace and consumer markets are rapidly evolving, SMEs that concentrate on digital renewal are more likely to convert innovation into performance gain. This research thus verifies that innovation programs must be placed within a wider strategic framework in order to bring about sustainable outcomes.

The research further corroborated hypothesis H3 by proving that the integration of resources mediates the role of technology innovation in influencing the performance of SMEs. This result underscores that innovation, by itself, will be inadequate to improve performance unless companies can marshal and coordinate internal and external resources in an integrated manner. This finding also has its foundation in DCT, which emphasizes the importance of companies' ability to configure, integrate, and reconfigure resources in highly dynamic environments (Jahanshahi et al., 2025). RI enables SMEs to leverage advances in technology by aligning them with employee competencies, knowledge bases, infrastructure, supplier networks, and customer relationships. This intermediary role aligns with the arguments presented by Wang and Zhang (2025) who suggest that the capacity to integrate resources is crucial for SMEs to utilize new knowledge and operationalize technological investments. Within the Chinese SME environment, where resources are typically limited, the strategic combination of partnerships, mechanisms for knowledge sharing, and human resource capacity-building programs is critical in driving innovation-led growth. This study thus provides both theoretical and managerial contributions by demonstrating that integrating resources is a crucial competence that enables SMEs to convert TI into enhanced performance. This also reinforces the view that successful innovation strategies must be supported by a systemic, organization-wide effort to synchronize technology with people, processes, and partnerships.

The findings of this research further validate hypothesis H4, which stated that SO moderates the TI-SME performance relationship positively, i.e., the relationship is higher when SO is high. The observation emphasizes the imperative nature of an organization's strategic stance for utilizing TIs to yield better performance outcomes. SO is a firm's market orientation, innovation focus, and long-term perspective, all of which shape the interpretation, prioritization, and utilization of technological resources (Abdullah et al., 2024). Firms that have a strong SO are more likely to regard innovation not only as a technical upgrade but also as a pivotal driver of value creation and a source of competitive advantage. In accordance with the RBV, the moderating effect of SO focuses on how managerial intent and in-house organizational capabilities influence how far TI is translated into performance improvement. This result is in concordance with earlier studies by researchers like (Iqbal et al., 2023; Zakhidov, 2024) showing that firms that integrate innovation through planning perform better than those firms that embrace innovation in an ad hoc or reactionary style. For Chinese SMEs, where managerial vision and responsiveness become even more critical due to resource constraints, firms that proactively harmonize their innovation activities with strategic goals are better positioned to harness technological resources for top-line growth, business development, and operational excellence. The study thus makes a theoretical contribution by showing that SO not only impacts innovation activities but also amplifies their role toward firm performance.

As such, the hypothesis test H5 confirms that MD positively mediates the link between TI and SME performance, implying that this link grows stronger with higher market dynamism. MD, which represents the velocity and unpredictability of customer taste changes, competitors' moves, and technological advancements, poses threats and opportunities to SMEs (Amin et al., 2023). The findings suggest that when the change is intense and recurrent, technologically innovative SMEs are more likely to achieve improved performance since they respond quickly and adaptably to shifting market demands. This evidence supports the DCT, which suggests that sensing, seizing, and transforming are crucial in turbulent environments (Teece et al., 1997). In such settings, TI stands as a key adaptive process that can help firms remold offerings, streamline processes, and architect responsive customer solutions. Evidence from the empirical studies of Aggrawal and Pandey (2025) and Jahanshahi et al. (2025) supports the claim, showing that market dynamism can trigger the capacity of companies to take advantage of the benefits of innovation. In the rapidly changing Chinese market, where consumer transformation and digital disruption are prevalent, SMEs that invest in innovation and operate in highly dynamic industries, such as fintech, e-commerce, or high-tech manufacturing, reap a significant performance dividend. This research thus contributes to the growing body of literature that views external environmental forces not only as threats but also as drivers that enhance the value of internal innovation efforts. It demonstrates that the alignment between internal innovation capability and external market conditions is crucial in determining performance outcomes, reinforcing the strategic interplay between firm-level decisions and environmental contexts.

Together, the results of this study provide a comprehensive picture that emphasizes the prominent role of technological innovation (TI) in determining SME performance, especially when moderated by transformative capabilities and influenced by contextual factors. The acceptance of all the hypothesized hypotheses supports a multi-layered framework in which innovation serves as the primary driver. By integrating conceptual perspectives from both the Dynamic Capabilities Theory (DCT) and the Resource-Based View (RBV), the study not only advances academic understanding but also offers practical recommendations for SME practitioners and policymakers seeking to promote innovation-led growth. For Chinese SMEs, where responsiveness, strategic direction, and agility are critical for survival, the insights highlight the importance of developing digital infrastructure, fostering cooperative resource practices, and adopting a forward-looking strategic approach. Finally, the study underscores that innovation alone is not a cure-all; rather, its success depends on how well it is embedded within the overall strategic and environmental framework of the organization.

6. CONCLUSION

The conclusions of this research, as mediated by the RBV and DCT, highlight that technological innovation increases SME performance through the development of SMEs' ability to create rare, valuable, and inimitable resources, as well as enhance their capacity to cope with dynamic environments. RBV theory points out that innovation is responsible for developing in-house assets like leading processes, digital infrastructures, and integrated resources that provide the basis for long-term competitive advantage. Supplementing this, DCT indicates that not only should SMEs pursue innovative technologies, but they should also develop dynamic capabilities such as digital transformation preparedness and resource integration to reconfigure competencies and respond appropriately to evolving market conditions. The mediating roles of digital transformation and resource integration demonstrate how innovation translates into performance benefits when internal resources are converted into strategic strengths. The moderating roles of strategic orientation and market dynamics emphasize the importance of aligning internal innovation with external challenges and opportunities. Practical implications are significant: SME managers should prioritize digital investments, cross-functionally integrate processes, and develop strategic flexibility to maximize the benefits of innovation. Policymakers can facilitate innovation-led performance by creating enabling ecosystems that enhance the digital capabilities of SMEs and by investing in measures that help them overcome uncertain market environments, thereby supporting sustained growth and competitiveness.

6.1. Implications

This research offers the following practical implications for SME owners, managers, and policymakers seeking to enhance performance through innovation-led strategies. To begin with, SMEs need to understand that technological innovation (TI) is a dynamic driver of performance improvement; however, its impact rests firmly on how it is mainstreamed into organizational processes and accompanied by strategic intent. Top management should not only invest in emerging technologies but also ensure that such innovations align with the company's strategic goals and are adaptable to changing market demands.

The established mediating role of digital transformation (DT) and resource innovation (RI) suggests that innovation activity should be supplemented by investments in building digital capabilities and coordinated resource management to yield the best returns. This involves the development of digital literacy, the enhancement of IT infrastructure, and the building of partnerships for knowledge sharing and administrative efficiency. In addition, the significant moderating effects of MD and strategic orientation (SO) suggest that SME managers must continually evaluate and refine their strategic intent and environmental scanning capabilities. For SMEs operating in dynamic markets, a proactive, innovation-oriented approach can help leverage emerging trends and mitigate risk. Policymakers are, however, invited to craft support programs that promote not only access to frontier technologies but also training, strategic mentoring, and spaces for inter-firm collaboration to foster an environment that supports sustainable innovation and growth.

Theoretically, this research is valuable in that it extends our knowledge regarding how TI enhances SME performance through intricate mediating and moderating mechanisms. Following the RBV, this study affirms that TI is a valuable, rare, and inimitable resource that, when integrated with other organizational capacities in the proper manner, can provide a sustained competitive advantage. Through an exposition of the mediating roles of DT and RI, the current study builds upon RBV by illustrating how companies can translate innovative resources into performance results via capability development and resource orchestration. Moreover, the integration of DCT offers a more nuanced understanding of how factors such as MD in the external environment influence the innovation-performance nexus. The discovery that SO and MD significantly moderate the innovation-performance relationship is supported by the DCT hypothesis, which suggests that companies need to remodel their resource base to adjust and compete effectively continually. This dual-theory integration creates a more holistic framework for understanding SME innovation, implying that performance outcomes are not merely a function of innovation inputs but are contingent

upon internal strategic alignment and external environmental responsiveness. The study thereby enriches the innovation literature by highlighting the conditional pathways through which TI affects SME outcomes. It underscores the need for context-sensitive models in entrepreneurship and management research. One significant implication of this research is its contribution to the sustainability debate for SMEs in turbulent markets. The results verify that technological innovation, when supported strategically by digital transformation, resource integration, and forward-looking strategic orientation, can facilitate SMEs' resilience and long-term sustainability over mere short-term competitive advantage. In volatile contexts, SMEs frequently experience resource shortages, uncertain consumer needs, and disruptive technology changes, so sustainability is not only a sought-after objective but an imperative to survival. Through innovation-enabled efficiency improvement, waste minimization, and optimal utilization of resources, SMEs can integrate business expansion with sustainable strategies, thereby enhancing their resilience against external shocks. Additionally, the moderating influence of market dynamics emphasizes that SMEs in turbulent environments are able to maintain performance by using adaptive strategies that infuse innovation into adaptive business models. This implies that SME sustainability results not only from environmental and social responsibility but also through strategic adaptability and capability development that enable companies to constantly renew themselves. Thus, this study emphasizes that the development of innovation-led sustainability is imperative for SMEs aiming to survive in uncertain and dynamic market environments.

6.2. Limitations and Future Directions

While this study has been of great value, it has some limitations, which provide multiple avenues for future research. Firstly, the cross-sectional nature of the study restricts causal inference regarding the dynamic relationships between TI, mediators, moderators, and SME performance. Future studies may utilize longitudinal designs to track how relationships evolve, particularly in response to changes in market conditions or internal strategic shifts. Second, although the sample was drawn from SMEs within China, which provides a fertile context for innovation due to its dynamic economy, the geographic focus may limit the generalizability of the results to other economic and cultural contexts.

Cross-country or cross-regional comparative studies may yield a broader view of how institutional environments and national innovation systems influence the innovation-performance relationship. Third, the research relied primarily on self-reported data from SME managers, which may subject the study to common method bias or subjective performance measurement. Future studies could enhance measurement validity by utilizing objective performance data or multi-informant responses. Furthermore, in addition to digital change and resource consolidation being proposed as essential mediators, other constructs that may be studied further to shed light on the mechanisms underlying innovation outcomes include organizational learning, absorptive capacity, or entrepreneurial orientation. Finally, future research may also examine industry-specific variables or government policy in influencing the effectiveness of TI in SMEs, with a more subtle and policy-oriented conceptualization of innovation ecosystems.

Funding: This study received no specific financial support.
Institutional Review Board Statement: This study was approved by the Institutional Review Board of Beijing Normal University, China, under protocol number (IRB Protocol Number: BNUIRB-2025-017), dated (Approval Date: 15 March 2025). Participation in the study was voluntary, and informed verbal consent was obtained from all respondents prior to data collection. To ensure confidentiality, all responses were anonymized, and no personally identifiable information was collected or stored.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

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