

Impact of Digital Transformation on the Sustainability Performance of SMEs: The Moderating Role of Government Digital Support

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Abstract

This study examines the association between digital transformation and the sustainable performance of small and medium-sized enterprises by considering the mediating roles of green innovation capability and dynamic capabilities and the moderating role of government digital support. The study integrates organizational capabilities and institutional support into a unified mechanism for explaining how digitalization is associated with economic, environmental, and social performance outcomes in an emerging economy. A two-stage design was employed: a qualitative instrument-refinement phase with structured discussions involving 35 enterprise directors in Ho Chi Minh City and Dong Nai, followed by a cross-sectional quantitative survey. This Study distributed 800 online questionnaires to respondents involved in digital transformation activities and retained 751 usable responses. The conceptual model comprised five reflective constructs and ten hypotheses. The study results show that digital transformation has the strongest direct positive association with sustainable performance and is also positively associated with green innovation capability and dynamic capabilities. Green innovation capability partially mediates the relationships between digital transformation and sustainable performance and between dynamic capabilities and sustainable performance. By contrast, dynamic capabilities do not independently mediate the digital transformation-sustainable performance relationship. Government digital support is positively associated with sustainable performance and strengthens the positive relationship between green innovation capability and sustainable performance. Given the cross-sectional, single-informant design, the findings are interpreted as associations rather than causal effects. The results suggest that managers should align digital investments with green innovation objectives, while policymakers should design digital support programs that help enterprises translate technology adoption into scalable, sustainable business outcomes.

Keywords: Digital Transformation, Green Innovation Capability, Sustainable Performance, Government Digital Support, SMEs

1. Introduction

Digital transformation has become a central strategic issue for small and medium-sized enterprises (SMEs) because digital technologies increasingly shape how firms organize processes, engage customers, mobilize knowledge, and compete. Recent research shows that SME digitalization is not merely an information-technology adoption problem; it involves changes in strategy, organizational culture, capabilities, and business models [1]. Digital platforms, digital capabilities, and technology adoption can strengthen innovation and performance, but their benefits depend on how firms integrate them into organizational routines and strategic decision-making [2].

The sustainability implications of digital transformation are particularly relevant for SMEs in emerging economies. SMEs frequently operate with tighter resource constraints, less formalized management systems and weaker access to specialized capabilities than larger firms [3]. At the same time, they face increasing pressure to improve economic resilience, environmental responsibility and social outcomes. Recent studies link digital transformation with sustainable business outcomes, competitive advantage and ESG-related performance, while also emphasizing that the relationship is not automatic [4]. The critical question is therefore not only whether digital transformation improves sustainable performance, but how digital resources are converted into sustainability-relevant capabilities and under what external conditions this conversion becomes more effective. Green innovation capability offers a plausible mechanism for explaining this conversion. Digital tools can improve information availability, process visibility,

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resource monitoring, coordination, and experimentation, thereby creating conditions for cleaner products, greener processes, and more resource-efficient operations. A growing literature connects digitalization and the digital economy with green innovation and green development [5]. In parallel, research on green innovation shows that firms require organizational capabilities to translate environmental intentions into operational changes and sustainable outcomes [6]. This suggests that green innovation capability may constitute a mechanism through which digital transformation produces sustainable performance gains.

Dynamic capabilities provide an additional organizational perspective. In volatile environments, firms need to sense opportunities, seize them, and reconfigure resources. Digitalization may support these activities by improving information processing and strategic responsiveness, while dynamic capabilities can enable innovation and adaptation [7]. However, recent SME evidence also suggests that capability effects are contingent and may operate through more specific innovation mechanisms rather than directly producing strong sustainability outcomes [8]. This study therefore includes dynamic capabilities as an organizational capability construct while placing green innovation capability at the center of the sustainability mechanism.

External support is also important. Government programs can reduce resource constraints by improving access to finance, digital infrastructure, skills, information, and institutional support. Evidence from SMEs and MSMEs indicates that government support can enhance survival, performance, innovation, and the effectiveness of technology adoption [9]. Yet the role of government digital support as a boundary condition for converting green innovation capability into sustainable performance remains underexplored. The present study addresses this gap by testing whether government digital support both contributes directly to sustainable performance and strengthens the effect of green innovation capability on sustainable performance.

Empirically, the study focuses on SMEs in Ho Chi Minh City and Dong Nai, two major business locations in southern Vietnam. The research followed a two-stage design. First, structured discussions with 35 SME directors between May and July 2025 were used to refine scale wording and the conceptual model for the local context. Second, a cross-sectional online survey was administered from October to December 2025 to respondents involved in digital transformation activities in SMEs; 751 usable responses from 800 distributed questionnaires were retained for PLS-SEM analysis in SmartPLS 4.0. The quantitative evidence is therefore interpreted associationally rather than causally.

2. Literature Review

2.1. Digital transformation and dynamic capabilities

Digital transformation refers to the strategic use of digital technologies to change organizational processes, interactions, decisions, and business models. SME digitalization research increasingly treats transformation as a capability-building process rather than a narrow technology acquisition decision. Studies of SME digitalization show that organizational readiness, digital culture, strategic orientation, and digital resource configuration shape transformation outcomes [10]. Research on digital strategies further indicates that digital capabilities and digital culture transmit the effects of strategic digital orientation to business transformation and innovation [11].

Dynamic capabilities concern the firm's ability to respond to changing conditions by identifying opportunities, mobilizing resources and reconfiguring routines. Digital technologies increase the speed and breadth of information flows and can improve organizational sensing, coordination and experimentation. Evidence on digital innovation and organizational resilience suggests that digital resources interact with capability development to support adaptation and performance [12]. In SMEs, which typically have limited slack resources, digital transformation may be particularly important in enabling timely reconfiguration and decision-making. Accordingly, digital transformation is expected to strengthen dynamic capabilities.

H1: Digital Transformation positively affects Dynamic Capabilities.

2.2. Digital transformation and green innovation capability

Green innovation capability captures a firm's ability to develop and implement environmentally oriented products, processes, and solutions. Digitalization can support green innovation through real-time monitoring, data-driven resource optimization, enhanced internal collaboration, and faster experimentation. Empirical work on the digital

economy and enterprise digitization increasingly documents a positive connection with green technology innovation and green development [13], [14]. Similar evidence suggests that digitalization can reduce informational frictions and support environmental innovation at both firm and regional levels [15]. For SMEs, digital transformation may be especially relevant because digital tools allow relatively resource-constrained firms to redesign processes without necessarily replicating the physical investment structures of larger organizations. The resulting visibility and connectivity can help identify material waste, energy inefficiencies, customer demand for greener offerings, and opportunities for process improvement. Therefore, SMEs that advance digital transformation should exhibit stronger green innovation capability.

H2: Digital Transformation positively affects Green Innovation Capability.

2.3. Digital transformation and sustainable performance

Sustainable performance reflects the firm's capacity to achieve economic results while improving environmental and social outcomes. Digital transformation can contribute directly by raising process efficiency, improving customer responsiveness, enabling more informed decisions, and supporting new business models. Recent SME studies emphasize the relevance of digital transformation for sustainable competitive advantage and financial performance [16], [17]. Broader evidence also links digital transformation with ESG-related outcomes and sustainable business performance [18]. The effect is expected to be particularly salient in SMEs because digital tools may help compensate for resource limitations through improved coordination and information use. Technology adoption and digital platforms can also extend market reach and improve customer engagement, which can reinforce economic sustainability [19], [20]. The combined operational, market, and decision benefits provide a basis for expecting a positive direct relationship between digital transformation and sustainable performance.

The expected positive relationship should not be interpreted as uniformly linear or costless. For resource-constrained SMEs, intensive digital investment may initially increase implementation costs, cash-flow pressure, energy use, or electronic waste before efficiency and sustainability gains materialize. The present model tests the average linear association; financial constraints, managerial risk aversion, time horizons, and potential digital rebound effects are treated as important boundary conditions for future research.

H3: Digital Transformation positively affects Sustainable Performance.

2.4. Dynamic capabilities, green innovation and sustainable performance

Dynamic capabilities can support green innovation by enabling firms to detect environmental opportunities, mobilize relevant knowledge, and reconfigure processes. Research on green transformational leadership and dynamic capabilities indicates that capability development can stimulate green product and process innovation [21], [22]. Similarly, conceptual and empirical SME research suggests that green dynamic capability can improve sustainability performance through green innovation and related organizational mechanisms [23]. Innovation-capability studies also indicate that capability configurations matter for SME innovation outcomes and performance [24]. Dynamic capabilities may also contribute directly to sustainable performance because adaptive firms can respond more quickly to technological, market, and environmental changes. Nevertheless, the effect may be modest if dynamic capabilities are not translated into concrete innovation outputs. This possibility is relevant for SMEs, where broad organizational capabilities often need to be focused on specific operational initiatives before performance gains emerge. Consequently, the study tests both the direct effect of dynamic capabilities on sustainable performance and their effect on green innovation capability.

H4: Dynamic Capabilities positively affect Green Innovation Capability.

H5: Dynamic Capabilities positively affect Sustainable Performance.

2.5. Green innovation capability and sustainable performance

Green innovation is increasingly considered a strategic route to sustainable performance because it can reduce environmental burdens while generating differentiation, efficiency, and legitimacy benefits. Studies show that green technological innovation is associated with green growth, ecological sustainability, and stronger environmental outcomes [25], [26]. Environmental practices and green business strategies can also improve SME performance when

firms adopt proactive orientations and respond to regulatory pressure [27]. At the firm level, green innovation capability should allow SMEs to transform environmental opportunities into operational improvements, greener offerings, and resource savings. This logic is consistent with evidence showing that digitalization affects green innovation and that innovation-related capabilities are central to organizational performance [28], [29]. Accordingly, green innovation capability is expected to positively affect sustainable performance.

H6: Green Innovation Capability positively affects Sustainable Performance.

2.6. Government digital support as an institutional enabler and boundary condition

SMEs often depend on institutional support to overcome financial, technological, and capability constraints. Government support can improve access to finance, infrastructure, information, training, and innovation resources. Recent evidence shows that public support can improve SME survival and performance in technology-intensive contexts and strengthen technology adoption outcomes [30], [31]. Research from emerging economies also associates government policy and financial support with SME performance and sustainability [32], [33]. At the innovation level, government support can reduce uncertainty and lower experimentation costs. Government digital support may therefore have two roles. First, it can contribute directly to sustainable performance by helping SMEs obtain technologies, digital skills, advisory services, and institutional resources. Second, it may strengthen the conversion of green innovation capability into performance. A firm with strong green innovation capability may still face barriers to implementation, commercialization, or scaling [35], [36]. Digital public infrastructure, incentives, advisory programs, and supportive policies can reduce these constraints, allowing green innovation capability to generate stronger sustainable outcomes. This conditional logic motivates the moderation hypothesis.

H7: Government Digital Support positively affects Sustainable Performance.

H8: Government Digital Support positively moderates the relationship between Green Innovation Capability and Sustainable Performance, such that the relationship is stronger at higher levels of Government Digital Support.

2.7. Mediating role of green innovation capability

The preceding arguments imply that green innovation capability is a conversion mechanism. Digital transformation provides data, connectivity, and process visibility, but firms must translate these digital resources into environmentally meaningful products and processes to generate an additional sustainability payoff. Research linking digitalization to green innovation and green development supports this transmission logic [37], [38]. Therefore, green innovation capability is expected to carry part of the effect of digital transformation on sustainable performance. A similar mechanism is expected for dynamic capabilities. Dynamic capabilities provide adaptive capacity, but green innovation gives this capacity a concrete sustainability-oriented expression. Evidence connecting dynamic capabilities with green innovation and sustainability supports this mechanism [39], [40]. Consequently, green innovation capability is expected to mediate the relationship between dynamic capabilities and sustainable performance.

H9: Green Innovation Capability mediates the relationship between Digital Transformation and Sustainable Performance.

H10: Green Innovation Capability mediates the relationship between Dynamic Capabilities and Sustainable Performance.

Figure 1 presents the conceptual research model and illustrates the proposed relationships among digital transformation, dynamic capabilities, green innovation capability, government digital support, and sustainable performance. The figure is aligned with the ten hypotheses and distinguishes the direct, mediating, and moderating relationships tested in the empirical model.

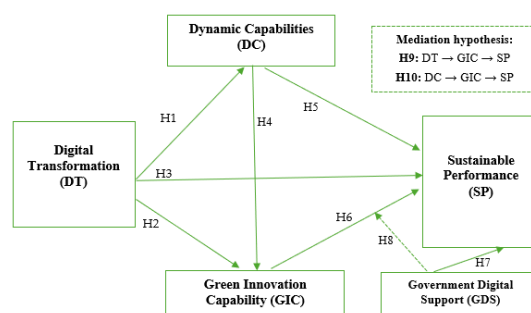


Figure 1. Conceptual research model for critical factors affecting sustainable performance

3. Methodology

3.1. Research design and context

The study used a two-stage research design in which a qualitative instrument-refinement phase preceded a cross-sectional quantitative PLS-SEM phase. The first phase was used to assess contextual relevance, clarity, and firm-level wording of established constructs rather than to generate a stand-alone qualitative theory. The second phase tested the measurement and structural relationships in a substantially larger sample. The empirical context included SMEs in Ho Chi Minh City and Dong Nai. These locations provide a relevant setting for studying digital transformation and sustainability because they contain dense populations of manufacturing and service SMEs and are closely integrated into the southern Vietnamese business ecosystem. The unit of observation in the survey is the individual informant. The inferential target is firm-level practices and outcomes as perceived by respondents involved in digital transformation activities; accordingly, the manuscript does not treat a single response as an objective firm-level record [41].

3.2. Qualitative phase and scale refinement

The qualitative instrument-refinement phase was conducted from May to July 2025 and involved 35 SME directors in Ho Chi Minh City and Dong Nai. Structured group discussions and scale-refinement conversations focused on whether the proposed constructs, relationships, and questionnaire items were understandable and relevant in the SME context. Discussion topics covered interpretations of digital transformation, the organizational meaning of dynamic capabilities, observable forms of green innovation, perceptions of government digital support, and the economic, environmental, and social dimensions of sustainable performance. Feedback was used to remove ambiguous wording, strengthen firm-level phrasing, and confirm the contextual relevance of the final five-construct model. Because the retained study records do not contain a formal coding frame, transcript-based thematic analysis, or a documented saturation criterion, this phase is reported conservatively as instrument and model refinement rather than as an independently analyzed qualitative study. The resulting questionnaire used five-point Likert-type response categories (1 to 5).

3.3. Quantitative survey and sample

This Study implemented the quantitative survey from October to December 2025 using criterion-based electronic recruitment: invitations were directed to people involved in digital transformation activities in SMEs in Ho Chi Minh City and Dong Nai. A total of 800 questionnaires were distributed by email and 751 usable questionnaires were retained after usability screening, equivalent to a usable yield of 93.9%. The retained study materials do not provide a verified breakdown of the remaining 49 cases into non-response, incomplete responses, or specific exclusion categories; therefore, the manuscript avoids interpreting 93.9% as a conventional probability-sample response rate. The final sample consisted of 306 male respondents (40.7%) and 445 female respondents (59.3%). The largest age group was 35 to under 45 years (52.3%), followed by 25 to under 35 years (23.6%), 45 years and above (16.1%), and under 25 years (8.0%). By firm type, limited liability companies represented 31.7% of the sample, private firms 29.8%, joint ventures 19.8%, and joint-stock companies 18.6%. Regarding firm age, 37.4% had operated for 10 to under 15 years and 34.0% for at least 15 years. Respondent job-position, organizational-tenure, unique-firm identifiers, and a verified industry/firm-size cross-tab are not available in the retained materials, which limits assessment of informant representativeness, within-firm duplication, and sectoral robustness.

3.4. Measures and analytical procedure

The final measurement model comprised five reflective constructs: Digital Transformation (DT, three items), Dynamic Capabilities (DC, four items), Government Digital Support (GDS, three items), Green Innovation Capability (GIC, three items), and Sustainable Performance (SP, three items). This Study conceptualized sustainable performance as a firm-level outcome reflecting the combined economic, environmental, and social orientation of performance. This Study included the interaction term $GDS \times GIC$ to test the proposed boundary condition. This Study operationalized all constructs using multi-item reflective measures adapted from recent studies and refined to fit the context of Vietnamese SMEs. This Study reviewed the initial measurement items and modified them contextually through qualitative discussions with 35 SME directors in Ho Chi Minh City and Dong Nai. All items were measured using a five-point Likert scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”).

Digital Transformation (DT) was measured using three items capturing the extent to which SMEs integrate digital technologies into core business processes, decision-making, and product, service, or business-model development. This Study adapted the items primarily from [39], [42]. This Study assessed Dynamic Capabilities (DC) using four items representing firms' abilities to sense environmental changes and opportunities, seize emerging opportunities, reconfigure resources, and continuously renew organizational capabilities. This Study adapted the measurement from [43], [44].

This Study operationalized Green Innovation Capability (GIC) with three items reflecting SMEs' ability to develop environmentally friendly products and services, improve green processes, and employ technologies and new ideas to reduce resource use and environmental impacts. These measures were adapted from [45], [46]. Government Digital Support (GDS) was measured with three items assessing managers' perceptions of how government policies, resources, incentives, services, and digital initiatives facilitate firms' digital transformation. The items were adapted to the Vietnamese SME context based on [47], [48].

Finally, Sustainable Performance (SP) was measured using three items reflecting economic, environmental, and social performance. The measures were adapted from [49], [50]. Higher scores indicate higher perceived sustainable performance of the focal SME. PLS-SEM was conducted using SmartPLS 4.0. The analysis proceeded in stages. First, descriptive statistics were reviewed. Second, This Study assessed the reflective measurement model using indicator loadings, Cronbach's alpha, composite reliability, and average variance extracted (AVE). Third, This Study examined collinearity using variance inflation factors (VIF). Fourth, This Study evaluated the structural model using path coefficients, bootstrapped t-statistics and p-values, R-squared values, and model fit information. Fifth, This Study examined specific indirect effects to test mediation. This Study used the interaction term to evaluate moderation. Finally, predictive assessment and importance-performance map analysis (IPMA) complemented the explanatory results with predictive and managerial interpretation.

4. Results and Discussion

4.1. Descriptive statistics and measurement model assessment

The observed means show moderate levels across most constructs. Dynamic capability items had means between 2.929 and 3.080, while green innovation capability items were somewhat higher, ranging from 3.170 to 3.317. Digital transformation items ranged from 2.426 to 2.547. Government digital support items ranged from 2.369 to 2.515, and sustainable performance items ranged from 2.350 to 2.458. All indicators used the full observed response range from 1 to 5. The item-level normality tests were significant, supporting a variance-based structural modeling approach that does not require multivariate normality. All indicator loadings exceeded 0.77. Digital Transformation loadings ranged from 0.811 to 0.869; Dynamic Capabilities from 0.841 to 0.904; Government Digital Support from 0.778 to 0.915; Green Innovation Capability from 0.916 to 0.948; and Sustainable Performance from 0.836 to 0.870. These results indicate strong indicator reliability and provide no empirical basis for deleting items from the reported measurement model. Internal consistency reliability was also satisfactory. Cronbach's alpha ranged from 0.799 for Digital Transformation to 0.922 for Green Innovation Capability. Composite reliability (ρ_c) ranged from 0.882 to 0.950. AVE values ranged from 0.713 to 0.864, showing that each construct explained a substantial proportion of the variance in its indicators. Overall, the results indicate adequate reliability and convergent validity.

Table 1 presents the assessment of reliability and convergent validity for the five constructs included in the research model. All constructs demonstrate satisfactory internal consistency, with Cronbach's alpha values ranging from 0.799 to 0.922 and composite reliability values ranging from 0.882 to 0.950. The average variance extracted values range from 0.713 to 0.864, exceeding the recommended threshold and confirming adequate convergent validity. Green innovation capability records the highest reliability and variance extracted, while digital transformation shows the lowest but still acceptable values. Overall, the results confirm that the measurement scales are reliable and suitable for subsequent structural model analysis. The SmartPLS output and insert all ten pairwise HTMT values for DT, DC, GDS, GIC, and SP; verify each value against the reviewer's strict 0.85 criterion.

Table 1. Reliability and convergent validity

Construct	Items	No.	Cronbach α	rho a	rho c	AVE
Digital Transformation (DT)	DT1–DT3	3	0.799	0.806	0.882	0.713
Dynamic Capabilities (DC)	DC1–DC4	4	0.907	0.949	0.934	0.779
Government Digital Support (GDS)	GDS1–GDS3	3	0.817	0.830	0.892	0.734
Green Innovation Capability (GIC)	GIC1–GIC3	3	0.922	0.950	0.950	0.864
Sustainable Performance (SP)	SP1–SP3	3	0.815	0.815	0.890	0.730

4.2. Structural model and direct effects

Structural collinearity was not a concern: VIF values for the reported structural predictor sets ranged from 1.000 to 1.178. The model explained 55.0% of the variance in Sustainable Performance (adjusted $R^2 = 0.547$). The explained variance was much lower for Green Innovation Capability ($R^2 = 0.069$) and especially Dynamic Capabilities ($R^2 = 0.006$). Thus, although the DT $\rightarrow$ DC coefficient is statistically significant, its magnitude ($\beta = 0.081$) and associated R^2 indicate very limited substantive explanatory power. H1 is therefore statistically supported but should not be interpreted as evidence that digital transformation is a major determinant of dynamic capabilities in this sample. The estimated model produced an SRMR of 0.071. Digital Transformation had the strongest direct association with Sustainable Performance ($\beta = 0.453$, $t = 12.770$, $p < 0.001$). It was also positively associated with Green Innovation Capability ($\beta = 0.237$, $t = 6.253$, $p < 0.001$) and Dynamic Capabilities ($\beta = 0.081$, $t = 2.219$, $p = 0.027$). Dynamic Capabilities were positively associated with Green Innovation Capability ($\beta = 0.093$, $t = 3.115$, $p = 0.002$) and Sustainable Performance ($\beta = 0.049$, $t = 2.231$, $p = 0.026$). Green Innovation Capability was positively associated with Sustainable Performance ($\beta = 0.282$, $t = 10.250$, $p < 0.001$). Government Digital Support was also positively associated with Sustainable Performance ($\beta = 0.290$, $t = 8.982$, $p < 0.001$). Finally, the GDS $\times$ GIC interaction was positive and significant ($\beta = 0.067$, $t = 2.870$, $p = 0.004$), supporting the proposed moderation effect.

Table 2 reports the original-sample coefficients, bootstrap sample means, and 95% percentile bootstrap confidence intervals for all eight direct structural paths. None of the reported intervals crosses zero. Digital Transformation has the strongest direct association with Sustainable Performance ($\beta = 0.453$, 95% CI [0.386, 0.525]), followed by Government Digital Support ($\beta = 0.290$, 95% CI [0.226, 0.355]) and Green Innovation Capability ($\beta = 0.282$, 95% CI [0.226, 0.334]). The DT $\rightarrow$ DC path is statistically positive but substantively weak ($\beta = 0.081$, 95% CI [0.007, 0.150]) and corresponds to only 0.6% explained variance in Dynamic Capabilities. The moderation path GDS $\times$ GIC $\rightarrow$ SP is also positive ($\beta = 0.067$, 95% CI [0.023, 0.115]). Thus, H1-H8 are statistically supported, while the practical interpretation of H1 remains deliberately qualified by its small magnitude.

Table 2. Structural path estimates, bootstrap confidence intervals, and hypothesis tests

Hypothesis	Path	O (β)	M	2.5%	97.5%	t	p	Decision
H1	DT $\rightarrow$ DC	0.081	0.082	0.007	0.150	2.219	0.027	Supported
H2	DT $\rightarrow$ GIC	0.237	0.238	0.163	0.312	6.253	<0.001	Supported
H3	DT $\rightarrow$ SP	0.453	0.455	0.386	0.525	12.770	<0.001	Supported
H4	DC $\rightarrow$ GIC	0.093	0.094	0.035	0.151	3.115	0.002	Supported
H5	DC $\rightarrow$ SP	0.049	0.050	0.007	0.092	2.231	0.026	Supported
H6	GIC $\rightarrow$ SP	0.282	0.280	0.226	0.334	10.250	<0.001	Supported
H7	GDS $\rightarrow$ SP	0.290	0.290	0.226	0.355	8.982	<0.001	Supported
H8	GDS $\times$ GIC $\rightarrow$ SP	0.067	0.067	0.023	0.115	2.870	0.004	Supported

4.3. Mediation analysis

Specific indirect effects clarify the organizational mechanisms associated with Sustainable Performance. The indirect association of Digital Transformation with Sustainable Performance through Green Innovation Capability was positive and statistically significant ($\beta = 0.067$, $t = 5.544$, $p < 0.001$). Because the direct $DT \rightarrow SP$ path also remained positive and significant, Green Innovation Capability represents complementary partial mediation, supporting H9. Green Innovation Capability also mediated the association between Dynamic Capabilities and Sustainable Performance ($\beta = 0.026$, $t = 2.957$, $p = 0.003$); with the positive direct $DC \rightarrow SP$ path retained, this is also complementary partial mediation, supporting H10. In contrast, $DT \rightarrow DC \rightarrow SP$ was not significant ($\beta = 0.004$, $p = 0.140$), and $DT \rightarrow DC \rightarrow GIC \rightarrow SP$ was not significant at the 5% level ($\beta = 0.002$, $p = 0.099$). Based on the reported coefficients, the $DT \rightarrow SP$ total indirect association across the three reported routes is 0.073 ($= 0.067 + 0.004 + 0.002$), giving an approximate total association of 0.526 when combined with the direct path (0.453). For $DC \rightarrow SP$, the reported direct association is 0.049, the indirect association through GIC is 0.026, and the corresponding total association is approximately 0.075. These decompositions do not replace bootstrap confidence intervals.

Table 3 shows specific indirect effects that clarify the mediating mechanisms linking digital transformation and dynamic capabilities to sustainable performance. Green innovation capability significantly mediates the relationship between digital transformation and sustainable performance, with an indirect effect of 0.067, supporting H9. It also significantly mediates the effect of dynamic capabilities on sustainable performance, with an indirect effect of 0.026, supporting H10. In contrast, the indirect effect of digital transformation through dynamic capabilities is not significant, and the serial mediation pathway through dynamic capabilities and green innovation capability is also unsupported. Overall, green innovation capability emerges as the principal mediating mechanism in the proposed model.

Table 3. Specific indirect effects

Indirect relationship	β	t	p	Interpretation
$DT \rightarrow GIC \rightarrow SP$	0.067	5.544	<0.001	Significant; H9 supported
$DC \rightarrow GIC \rightarrow SP$	0.026	2.957	0.003	Significant; H10 supported
$DT \rightarrow DC \rightarrow SP$	0.004	1.476	0.140	Not significant
$DT \rightarrow DC \rightarrow GIC \rightarrow SP$	0.002	1.652	0.099	Not significant
$DT \rightarrow DC \rightarrow GIC$	0.007	1.647	0.100	Not significant

4.4. Moderation, predictive assessment and IPMA

The statistically significant interaction coefficient for $GDS \times GIC \rightarrow SP$ ($\beta = 0.067$, $p = 0.004$) indicates that Government Digital Support strengthens the positive $GIC \rightarrow SP$ association. Using the standardized structural coefficients and holding other predictors at their mean, the conditional $GIC \rightarrow SP$ slope is approximately 0.215 at low GDS (-1 SD), 0.282 at mean GDS, and 0.349 at high GDS (+1 SD). Figure 3 visualizes this interaction and shows that the positive association between Green Innovation Capability and Sustainable Performance becomes steeper as Government Digital Support increases. Figure 2 presents a publication-oriented visualization of the estimated structural model rather than a SmartPLS screenshot.

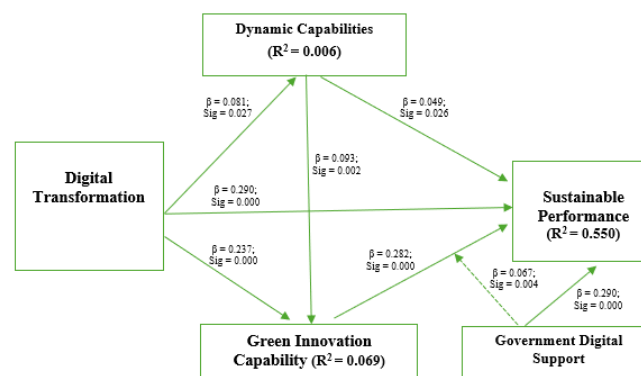


Figure 2. Testing critical factors influencing sustainable performance

Solid arrows denote direct paths to Sustainable Performance, dashed arrows denote capability-building/mediation-related paths, and the dash-dot path denotes the $GDS \times GIC$ moderation term. The $DT \rightarrow SP$ association is the strongest direct path ($\beta = 0.453$), followed by $GDS \rightarrow SP$ ($\beta = 0.290$) and $GIC \rightarrow SP$ ($\beta = 0.282$). The $DT \rightarrow DC$ association is statistically significant but substantively weak ($\beta = 0.081$; R^2 for $DC = 0.006$). The interaction term remains positive ($\beta = 0.067$), indicating a stronger $GIC \rightarrow SP$ association at higher levels of government digital support. Predictive assessment yielded $Q^2_{predict}$ values of 0.004 for Dynamic Capabilities, 0.056 for Green Innovation Capability, and 0.465 for Sustainable Performance. IPMA performance scores were 41.035 for Digital Transformation, 49.971 for Dynamic Capabilities, 48.009 for Government Digital Support, 56.208 for Green Innovation Capability, and 46.494 for Sustainable Performance. Digital Transformation has the greatest total-effect importance for Sustainable Performance while its performance level remains comparatively modest, suggesting managerial leverage from improving digital transformation practices. Figure 3 is based on the standardized structural coefficients ($\beta_{GIC} = 0.282$, $\beta_{GDS} = 0.290$, $\beta_{interaction} = 0.067$), with other predictors held at their mean. It is intended to clarify the direction and practical magnitude of the significant interaction; low and high GDS are represented at -1 SD and +1 SD, respectively.

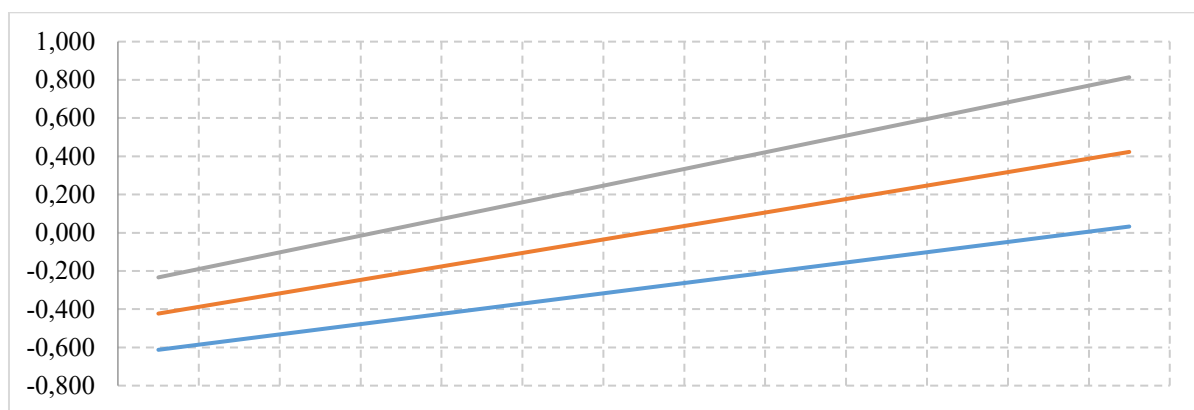


Figure 3. Simple-slope visualization of the $GDS \times GIC$ interaction on Sustainable Performance

4.5. Discussion of findings

(1) Digital transformation as the strongest observed performance correlate: The largest direct path in the model is Digital Transformation $\rightarrow$ Sustainable Performance ($\beta = 0.453$). This finding is consistent with literature that treats digital transformation as a strategic organizational change associated with business performance and sustainability rather than as a narrow technology investment [13], [14], [48]. The cross-sectional design does not establish temporal precedence or causality; therefore, the coefficient is interpreted as a strong positive association. In the sampled firms, digital transformation may be linked to sustainable performance through simultaneous channels such as process efficiency, information quality, responsiveness, customer interaction, new-product development, and decision speed. The strong direct path remains after accounting for green innovation capability, but this should not be read as proof that digitalization by itself causes sustainability gains.

(2) Green innovation capability as the key mediating mechanism: The most theoretically informative finding is the significant $DT \rightarrow GIC \rightarrow SP$ indirect effect. Digital transformation improves Green Innovation Capability, which in turn enhances Sustainable Performance. This result is consistent with research linking digitalization to green innovation and green development [18], [24], [49]. It also fits with evidence that green innovation contributes to ecological sustainability and broader performance outcomes. The mediation is partial rather than full. This distinction matters. Digitalization produces direct performance gains, but it also creates an additional sustainability pathway when digital capabilities are converted into greener products, processes and resource-use practices. The evidence therefore supports a conversion-mechanism interpretation: digital transformation supplies information, connectivity and operational visibility, while green innovation capability turns part of those digital advantages into sustainability-oriented action. This helps explain why studies of the digital economy often observe better green innovation outcomes where digital infrastructure and organizational digitalization are more advanced. The mediation result also complements evidence on environmental practices in SMEs. Proactive environmental orientation and green business strategy can support

performance, but firms require the organizational ability to implement these orientations in products and processes. Green Innovation Capability plays this role in the current model.

(3) The role of dynamic capabilities: Dynamic Capabilities had statistically significant but comparatively small direct associations with both Green Innovation Capability and Sustainable Performance. More importantly, GIC mediated the $DC \rightarrow SP$ relationship, while DC did not mediate $DT \rightarrow SP$. These findings qualify a simple capability-chain argument. The $DT \rightarrow DC$ path is weak ($\beta = 0.081$) and the R^2 for DC is only 0.006; accordingly, H1 is statistically supported but has limited substantive explanatory value. Digital transformation is associated with stronger dynamic capabilities, but the current model leaves almost all variance in DC unexplained. The results instead suggest that dynamic capabilities are more closely linked to sustainability when expressed through a more specific innovation capability. The non-significant serial mediation $DT \rightarrow DC \rightarrow GIC \rightarrow SP$ should not be interpreted as evidence that dynamic capabilities are irrelevant; rather, it indicates that the proposed sequential route is not supported by these cross-sectional data and that broader antecedents of dynamic capabilities should be examined in future research.

(4) Government digital support as a boundary condition: Government Digital Support showed a positive direct association with Sustainable Performance ($\beta = 0.290$) and a positive moderating association on the $GIC \rightarrow SP$ relationship ($\beta = 0.067$). This pattern is consistent with research linking public support to SME access to finance, technology, and performance-relevant resources [23], [34], [50], [51]. The moderation result adds a distinct contribution: Green Innovation Capability is more strongly associated with Sustainable Performance when the institutional environment provides greater digital support. This suggests complementarity between internal capability and external policy support, while the cross-sectional design does not establish causal direction. Supportive digital infrastructure, incentives, advisory programs, standards, and access mechanisms may help firms implement and scale green innovation, but this interpretation should be tested longitudinally.

5. Conclusion and Recommendations

5.1. Conclusions

This study examined how digital transformation is associated with the sustainable performance of SMEs by integrating dynamic capabilities, green innovation capability, and government digital support within a unified conceptual framework. Using a two-stage design and 751 usable cross-sectional survey responses from enterprises in Ho Chi Minh City and Dong Nai, the analysis shows that digital transformation has the strongest positive direct association with sustainable performance and is also positively associated with green innovation capability and dynamic capabilities. Green innovation capability emerges as the central mediating mechanism: it partially mediates the $DT \rightarrow SP$ relationship and transmits part of the $DC \rightarrow SP$ association. In contrast, dynamic capabilities do not independently mediate $DT \rightarrow SP$, and the serial mediation pathway is not statistically supported. Government digital support has both a positive direct association with sustainable performance and a positive moderating effect on the $GIC \rightarrow SP$ relationship. Because the study is cross-sectional and single-informant, these results should be interpreted as patterns of association rather than causal effects. The findings nevertheless indicate that digitalization, green innovation capability, and institutional support are jointly relevant to sustainable SME performance in this context.

5.2. Recommendations

(1) Theoretical recommendations: The study offers four theoretical recommendations. First, it shifts the digital transformation-sustainability debate from a direct-effect perspective to a mechanism-and-boundary-condition perspective. Rather than assuming that digital transformation automatically yields sustainability, the model demonstrates that Green Innovation Capability constitutes a significant transmission mechanism and Government Digital Support conditions the strength of the green innovation-performance relationship. Second, the study distinguishes between broad organizational capabilities and sustainability-specific capabilities. Dynamic Capabilities contribute to Green Innovation Capability and Sustainable Performance, but their effect is comparatively small, and they do not mediate the Digital Transformation $\rightarrow$ Sustainable Performance relationship. Green Innovation Capability, in contrast, has a substantially stronger direct effect on Sustainable Performance and mediates two important relationships. This supports the view that specific deployment capabilities may be more proximal predictors of performance than broad adaptive capabilities. Third, the analysis integrates organizational and institutional

explanations. Much SME digitalization research focuses primarily on internal technology and capability factors, while policy research typically treats government support as an antecedent of adoption or performance. By modeling government digital support as a moderator, the present study shows that policy support can influence the productivity of an internal capability. Fourth, the study contributes evidence from Vietnamese SMEs. Emerging-economy research on digitalization and innovation is growing, but contexts differ substantially in digital infrastructure, public policy, organizational maturity, and environmental pressure. The Ho Chi Minh City-Dong Nai setting demonstrates that digital transformation, green innovation, and government support are jointly relevant for sustainable SME performance in a rapidly transforming business environment.

Limitations and future research: The study has several limitations. First, the quantitative design is cross-sectional, so temporal ordering is theoretically motivated rather than directly observed; future longitudinal or quasi-experimental designs should test whether digital transformation precedes capability development and sustainability outcomes. Second, all five constructs were measured using single-informant perceptual Likert scales. A dedicated marker variable was not included, and a full-collinearity common-method diagnostic cannot be validly reconstructed from the retained manuscript/output materials; residual common-method variance therefore cannot be ruled out. Future validation should combine multiple informants with objective indicators such as digital investment, revenue growth, energy use, waste reduction, innovation outputs, or ESG-related metrics. Third, the empirical setting is limited to SMEs in Ho Chi Minh City and Dong Nai. The retained materials do not provide respondent-position/tenure variables, unique-firm identifiers, or a verified sector/size cross-tab, which limits assessment of informant representativeness, duplicate responses from the same SME, non-response patterns, and multi-group robustness across industries. Future studies should maintain a firm-level sampling frame and report recruitment flow, respondent roles and tenure, SME size and sector, and sector-specific multi-group tests. Fourth, the model explains only 0.6% of the variance in Dynamic Capabilities and 6.9% in Green Innovation Capability; leadership, organizational culture, employee digital skills, environmental orientation, absorptive capacity, competitive pressure, financial constraints, and managerial risk aversion are plausible additional antecedents or boundary conditions. Fifth, Government Digital Support is modeled as a single three-item construct. The present instrument does not support a valid post hoc disaggregation into subsidies, training, infrastructure, and regulatory support; future research should develop multi-item dimensions for these policy instruments and test their separate direct and moderating effects. Sixth, the positive linear specification may overlook short-run digital rebound effects, cash-flow pressure, implementation costs, and e-waste before longer-run efficiency benefits materialize. Future longitudinal research should test nonlinear effects and moderators such as financial constraints and managerial risk aversion. Finally, industry-specific analyses should determine whether the structural relationships differ between manufacturing and service SMEs, where digitalization and the environmental content of green innovation may differ.

6. Declarations

6.1. Author Contributions

Conceptualization: P.T.T., N.A.H.; Methodology: N.A.H.; Software: P.T.T.; Validation: P.T.T. and N.A.H.; Formal Analysis: P.T.T. and N.A.H.; Investigation: P.T.T.; Resources: N.A.H.; Data Curation: N.A.H.; Writing Original Draft Preparation: P.T.T. and N.A.H.; Writing Review and Editing: N.A.H. and P.T.T.; Visualization: P.T.T.; 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 appeared to influence the work reported in this paper.

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