“Digital transformation and internal control effectiveness: The moderating role of firm size in Vietnamese enterprises”

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DIGITAL TRANSFORMATION AND INTERNAL CONTROL EFFECTIVENESS: THE MODERATING ROLE OF FIRM SIZE IN VIETNAMESE ENTERPRISES

Abstract

In the dynamic landscape of emerging economies like Vietnam, digital transformation is increasingly recognized as a strategic imperative for enhancing corporate governance and transparency. This study aims to evaluate the direct impact of technological integration on internal control effectiveness and investigate the moderating mechanism of firm size in this relationship. To ensure representativeness across small, medium, and large organizational scales, a stratified random sampling technique was employed. The quantitative data were collected over a six-month period from October 2024 to March 2025. A structured questionnaire, validated by experts and utilizing a 5-point Likert scale, was distributed via email to key personnel in Vietnamese enterprises, resulting in 452 valid responses. The partial least squares structural equation modeling method was applied to analyze the data, specifically chosen for its suitability with non-normal distributions. The results demonstrate that digital transformation exerts a substantial positive influence on internal control effectiveness ($\beta = 0.424$, p-value < 0.001), confirming that digitization significantly bolsters risk management capabilities. Crucially, the analysis identifies a statistically significant negative moderating effect of firm size ($\beta = -0.190$, p-value < 0.001). These findings indicate that the positive impact of digitalization on internal control diminishes as organizational scale increases. The study concludes that while large corporations face structural inertia, small and medium-sized enterprises leverage their agility to achieve superior control outcomes, necessitating tailored strategies for different enterprise scales.

Keywords digital transformation, internal control effectiveness, firm size, emerging economy

JEL Classification O33, M15, M41, L25

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INTRODUCTION

The contemporary business environment is characterized by high volatility due to rapid digital innovation, shifting customer expectations, and the increasing centrality of data in strategic decision-making. Over the past decade, the pervasive integration of digital technologies has fundamentally restructured operational frameworks and corporate governance mechanisms globally. Digital transformation transcends mere technology adoption; it is a holistic paradigm shift in strategy, processes, and organizational culture designed to sustain competitiveness in the digital era. Within this landscape, internal control has emerged as a critical domain significantly influenced by technological advancement. As organizations deploy tools ranging from Robotic Process Automation to Artificial Intelligence, the traditional mechanisms of compliance, transparency, and risk management are undergoing a fundamental reconfiguration (Ashraf, 2025; Obaydin et al., 2025).

Although recent scholarship has begun to investigate the nexus between digital transformation and internal control (Alhinai et al., 2025),

the existing literature predominantly focuses on developed economies or treats firms as homogenous entities, neglecting the structural nuances of diverse organizational forms. Emerging economies like Vietnam present a unique context characterized by rapid digitization juxtaposed with distinct institutional voids and resource constraints. Specifically, Small and Medium-sized Enterprises account for approximately 98% of total enterprises in Vietnam and contribute significantly to the national GDP. Despite their economic importance, the digital readiness of these entities remains uneven compared to larger corporations, creating a potential vulnerability in governance mechanisms. A critical, yet underexplored dimension in this domain is the boundary condition of firm size. While large firms possess substantial resources, they often contend with structural inertia, whereas SMEs may utilize their organizational agility to integrate digital controls more effectively (Chen et al., 2023). Consequently, a significant scientific problem exists regarding how firm size interacts with digital transformation to influence Internal Control Effectiveness in transitional economies. It remains unclear whether organizational scale acts as a catalyst or a barrier in the digital-governance nexus, necessitating a focused investigation into this moderating mechanism.

1. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Digital transformation is defined as the strategic integration of digital technologies across all business functions, resulting in fundamental alterations to organizational operations and value creation processes (Davenport & Westerman, 2018). Beyond the implementation of isolated Information Technology tools, this transformation entails a comprehensive reorganization of workflows to enhance competitive positioning. In the specific context of Vietnam, digital transformation is regarded as a vital strategy for improving competitiveness amidst the pressures of global economic integration (Walsh et al., 2023). Within the scope of this study, digital transformation is operationalized through five core dimensions identified in seminal literature: operational Information Technology application (Davenport & Westerman, 2018), system integration (Ross et al., 2017), workflow automation (Chui et al., 2016), big data analytics (Chen et al., 2012), and strategic digital orientation (Kane et al., 2015). These dimensions collectively represent the technical and strategic capacity of a firm to leverage data for operational excellence.

Internal control effectiveness serves as a cornerstone of corporate governance, designed to provide reasonable assurance regarding the achievement of objectives related to operations, reporting, and compliance (COSO, 2013). The effectiveness of these controls is increasingly dependent on the quality and timeliness of information flow. Recent literature suggests that digital transformation fundamentally reshapes internal control effectiveness by enhancing the precision of risk assessment and the speed of information communication. For instance, Alhinai et al. (2025) proposed the Digital Audit-Control Integration model, which illustrates how digital tools reconfigure traditional COSO components, shifting from retrospective detective controls to predictive preventive measures. Similarly, empirical studies by Qin (2024) and Gao et al. (2023) demonstrate that digitization improves internal control quality by reducing information asymmetry and agency costs, thereby increasing the transparency of financial reporting.

The mechanism through which digital transformation enhances internal control lies in the automation of routine tasks and the analytical capability of advanced systems. The application of Artificial Intelligence and automation has been found to significantly reduce material weaknesses in internal controls by minimizing human error and facilitating continuous, real-time monitoring (Ashraf, 2025; Obaydin et al., 2025). Furthermore, Cheng et al. (2024) argue that digital transformation improves internal management throughout the enterprise life cycle by integrating disparate data silos into a unified governance framework. In the context of developing economies such as Vietnam, where traditional infrastructure may be underdeveloped, technological integration allows firms to rapidly adopt advanced governance models.

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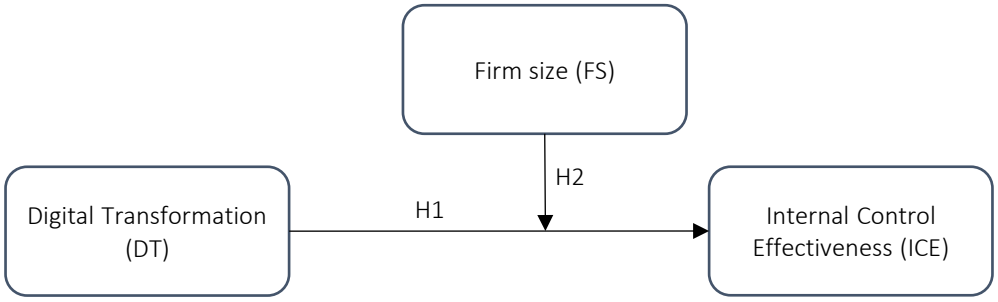

Figure 1. Proposed model

While the theoretical benefits of digital transformation are evident, its empirical impact on internal control effectiveness is likely non-uniform across organizations, being contingent upon internal characteristics, particularly firm size. Grounded in Contingency Theory (Fiedler, 1967), the effectiveness of any management system, including internal control, depends on its alignment with the organizational context. Firm size is a primary contingency factor that dictates resource availability, structural complexity, and decision-making speed.

Traditional perspectives, such as the Resource-Based View, suggest that larger firms are better positioned to exploit digital transformation due to superior financial reserves, specialized human capital, and established technical infrastructure (Tao et al., 2024). From this viewpoint, large enterprises should theoretically achieve higher internal control effectiveness from digitalization because they can afford sophisticated Enterprise Resource Planning systems and advanced security protocols. However, a growing body of evidence points to a distinct advantage for smaller firms, often referred to as digital agility. Yermack (1996) posits that larger organizations frequently suffer from structural inertia and bureaucratic complexity, which can impede the swift adaptation and optimal utilization of new technologies. As organizations grow, the complexity of their internal processes increases, potentially creating resistance to change and making the integration of new digital tools more challenging.

Empirical evidence from Chen et al. (2023) supports this perspective, finding that the positive effect of digital transformation on internal control quality is more pronounced in smaller enterprises. This is attributed to lower coordination costs, flatter hierarchies, and faster decision-making processes inherent in SMEs. In contrast, large enterprises may encounter challenges where the complexity of legacy systems attenuates the immediate efficiency gains of digital tools in the short term. The intricate layers of management and the rigidity of existing procedures in large firms can buffer the transformative potential of digital technologies. Consequently, while large firms have the resources to invest in digital transformation, the marginal improvement in internal control effectiveness per unit of investment may be lower compared to smaller, more agile firms that can fully integrate digital workflows with less structural resistance.

In summary, the literature establishes a clear link between digital transformation and improved internal control but reveals a theoretical tension between the resource advantages of large firms and the structural agility of smaller entities. This dichotomy suggests that firm size acts as a crucial boundary condition that may amplify or diminish the governance benefits of digitization. Despite this, there is a paucity of research examining this interaction within the specific institutional context of Vietnam. Therefore, the purpose of this study is to empirically examine the direct impact of digital transformation on internal control effectiveness and to investigate the moderating role of firm size to determine whether organizational scale facilitates or hinders this relationship.

Based on the theoretical framework and empirical evidence discussed, the following hypotheses are formulated:

H1: Digital transformation exerts a positive influence on internal control effectiveness.

H2: Firm size moderates the relationship between digital transformation and internal control effectiveness, such that the positive effect is stronger for smaller firms.

This conceptual framework is illustrated in Figure 1.

2. METHODS

To construct a comprehensive framework for assessing the impact of digital transformation on internal control effectiveness, this study adopted a sequential mixed-method design, prioritizing a quantitative approach supported by a preliminary qualitative validation phase (J. W. Creswell & J. D. Creswell, 2017). The research process commenced with the development of the measurement instrument, where scales were adapted from established international studies to ensure construct validity and reliability.

Specifically, Digital Transformation was operationalized as a multidimensional construct capturing the technological maturity required for modern governance (Vial, 2019). Reflecting the strategic imperative of digitization in the Vietnamese context (Walsh et al., 2023), the measurement scale integrates five core dimensions: operational Information Technology application for efficiency (Davenport & Westerman, 2018), system integration for transparency (Ross et al., 2017), workflow automation to minimize errors (Chui et al., 2016), big data utilization for decision-making (Chen et al., 2012), and long-term strategic digital orientation (Kane et al., 2015). Concurrently, Internal Control Effectiveness was evaluated based on the COSO (2013) framework, focusing on the system's capacity to reduce agency costs and conflicts of interest (Jensen & Meckling, 1976). This construct encompasses five dimensions: systematic control processes (Arens et al., 2017), strict regulatory adherence, risk identification and mitigation (DeFond & Zhang, 2014), timely information feedback (Kaplan & Norton, 1996) and continuous monitoring (Power, 2007).

Given the linguistic and cultural nuances of the Vietnamese business environment, a rigorous translation and back-translation procedure was employed (Brislin, 1970). The initial Vietnamese draft was subsequently reviewed by a panel of six experts, comprising three senior practitioners in corporate governance and three academics specializing in accounting information systems, to verify face validity and content validity. Based on expert feedback, minor terminological adjustments were made to ensure that technical indicators were linguistically accurate and comprehensible to local respondents. The complete questionnaire is provided in the Appendix.

The primary data collection was conducted over a six-month period, from October 2024 to March 2025. This timeframe was strategically selected as it coincides with the post-pandemic acceleration phase of Vietnam's national digital transformation program, providing a relevant context for observing the integration of digital tools in corporate governance. The study focused on enterprises operating within Vietnam, a representative emerging economy characterized by rapid technological adoption amidst resource constraints. To ensure sample representativeness across different organizational scales, a stratified random sampling technique was utilized, categorizing the population into three strata based on firm size: small, medium, and large enterprises. The survey procedure adhered to the "Tailored Design Method" (Dillman et al., 2014) to maximize response rates, involving personalized invitation emails and three periodic reminders. A total of 470 questionnaires were distributed. Following a strict data screening process to eliminate incomplete responses or those exhibiting unengaged response patterns, 452 valid responses were retained for the final analysis. This sample size exceeds the minimum threshold required for Structural Equation Modeling to achieve a statistical power of 80% at a significance level of 0.05 (Hair et al., 2019). The dataset employed in this analysis is unique to this study and has not been utilized in prior publications.

The quantitative analysis is grounded in this valid dataset of 452 enterprises, the characteristics of which are detailed in Table 1. An examination of the respondent profile reveals a sample characterized by a high level of professional expertise and decision-making authority. Specifically, senior personnel such as Chief Accountants (43.5%) and Chief Financial Officers (38.1%) constitute the

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Table 1. Description of research sample characteristics

Characteristic	Demographics	Frequency	Percentage (%)
Position	Chief Financial Officer (CFO)	172	38.1
	Chief Accountant	197	43.5
	Head/Deputy Head of Internal Control	83	18.4
Education Level	Bachelor's Degree	263	58.2
	Master's Degree or Higher	189	41.8
Work Experience	3-7 years	105	23.2
	8-15 years	245	54.2
	> 15 years	102	22.6
Industry Sector	Manufacturing & Industrial	127	28.1
	Services (Finance, Trade, Logistics)	210	46.5
	Information Technology & Telecommunications	94	20.8
	Other	21	4.6
Enterprise Size	Small	139	30.7
	Medium	220	48.7
	Large	93	20.6

Note: N = 452.

vast majority of respondents. This concentration of high-ranking officials ensures that the data reflects informed perspectives on internal control and digital strategies. Furthermore, the respondents exhibit a high level of professional qualification; 41.8% hold a Master's degree or higher, while 58.2% possess a Bachelor's degree. Professional experience is equally substantial, with over 76% of participants having accumulated more than eight years of expertise in their respective fields, thereby lending significant credibility to their assessments. Regarding organizational characteristics, the sample exhibits diverse sectoral representation, dominated by the service sector (46.5%), followed by manufacturing (28.1%) and Information Technology/Telecommunications (20.8%). Crucially for the study's specific focus on moderation effects, the distribution of firm size is balanced, with medium-sized enterprises accounting for the largest share (48.7%), followed by small (30.7%) and large enterprises (20.6%).

Regarding ethical considerations, this study was conducted in full compliance with international ethical standards for research involving human subjects. Informed consent was explicitly obtained from all participants via the survey cover letter, which clearly articulated the research objectives, the voluntary nature of participation, and the right to withdraw at any stage. Anonymity and confidentiality were strictly maintained; no personally identifiable information was stored, and the encrypted data were accessible solely to the research team for academic purposes.

Finally, the collected data were processed and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS 4 software. This analytical approach was selected due to its superior capability in handling non-normal data distributions and its suitability for exploratory research models involving complex moderating relationships (Hair et al., 2019). The analysis proceeded in two systematic stages: first, the assessment of the measurement model to establish reliability, convergent validity, and discriminant validity; and second, the evaluation of the structural model to test the hypothesized relationships (H1 and H2), including the interaction analysis of firm size. Common Method Bias was also assessed using Harman's single-factor test and variance inflation factors to ensure the integrity of the results.

3. RESULTS

To ensure the integrity of the data before proceeding to structural analysis, Common Method Bias (CMB) was rigorously assessed using the full collinearity test proposed by Kock (2015). Given that data for both dependent and independent vari-

ables were collected from a single source, checking for systematic bias is crucial. As presented in Table 2, the Variance Inflation Factor (VIF) values for all latent constructs range from a minimum of 1.000 to a maximum of 3.195. Importantly, all reported values fall consistently below the critical threshold of 3.3 suggested by Kock (2015). This result provides statistical evidence that the dataset is free from significant common method bias, implying that CMB does not considerably influence the research results, thereby validating the structural relationships examined in subsequent steps.

Table 2. Summary of variance inflation factor (VIF) for component indicators

Latent construct (Indicator)	VIF range
DT1-DT5	2.263-2.487
ICE1-ICE5	2.775-3.195
FS	1.000
FS × DT	1.000

Following the bias assessment, the measurement model was evaluated focusing on internal consistency reliability and convergent validity. Table 3 summarizes the results for the reflective constructs. In terms of reliability, the constructs demonstrated high internal consistency, with Cronbach's alpha coefficients ranging from 0.904 to 0.931, and composite reliability (Rho_C) values ranging from 0.928 to 0.947. These figures well exceed the recommended threshold of 0.7 established by Hair et al. (2019), indicating robust reliability. Convergent validity was also established, as all outer loadings of the indicators were significant, ranging from 0.834 to 0.891, surpassing the standard benchmark. Furthermore, the Average Variance Extracted (AVE) values for Digital Transformation (0.722) and Internal Control Effectiveness (0.783) were significantly higher than the 0.50 criterion recommended by Fornell and Larcker (1981), confirming that the constructs explain more than half of the variance of their indicators. Discriminant validity was assessed using the Heterotrait-Monotrait ratio of correlations (HTMT), which is considered superior to traditional criteria for variance-based SEM. As displayed in Table 4, all HTMT ratios are well below the conservative threshold of 0.85 suggested by Henseler et al. (2015), with values ranging from 0.371 to 0.570. To further strictly verify this, a bootstrapping procedure with 5,000 subsamples was conducted to generate 95% confidence intervals. The results indicate that none of the confidence intervals include the value of 1, thereby providing conclusive evidence that the latent variables are empirically distinct.

Following the validation of the measurement model, the structural model was assessed to determine the model's explanatory power and the significance of the path coefficients, as visually illustrated in Figure 2.

With the measurement model validated, the structural model was assessed to determine the explanatory power and the significance of the path coefficients. The model explains a substantial proportion of the variance in the dependent variable, with an R^2 value of 0.369 for internal control effectiveness. According to Hair et al. (2019), this indicates a moderate level of explanatory power, showing that 36.9% of the fluctuations in internal control effectiveness are accounted for by Digital Transformation, firm size, and their interaction. Regarding the effect size (f^2), the analysis in Table 5 reveals that Digital Transformation has a medium effect size on internal control effectiveness ($f^2 = 0.248$), whereas firm size and the interaction

Table 3. Evaluating the measurement model

Variables	Cronbach's Alpha	Composite reliability (Rho_C)	Average variance extracted (AVE)	Outer loadings (Min-Max)
DT	0.904	0.928	0.722	0.834-0.863
ICE	0.931	0.947	0.783	0.874-0.891

Table 4. HTMT confidence intervals based on bootstrapping

Value	Confidence intervals 95%
FS-DT: 0.371	0.286-0.448
ICE-DT: 0.570	0.507-0.629
ICE-FS: 0.431	0.362-0.495

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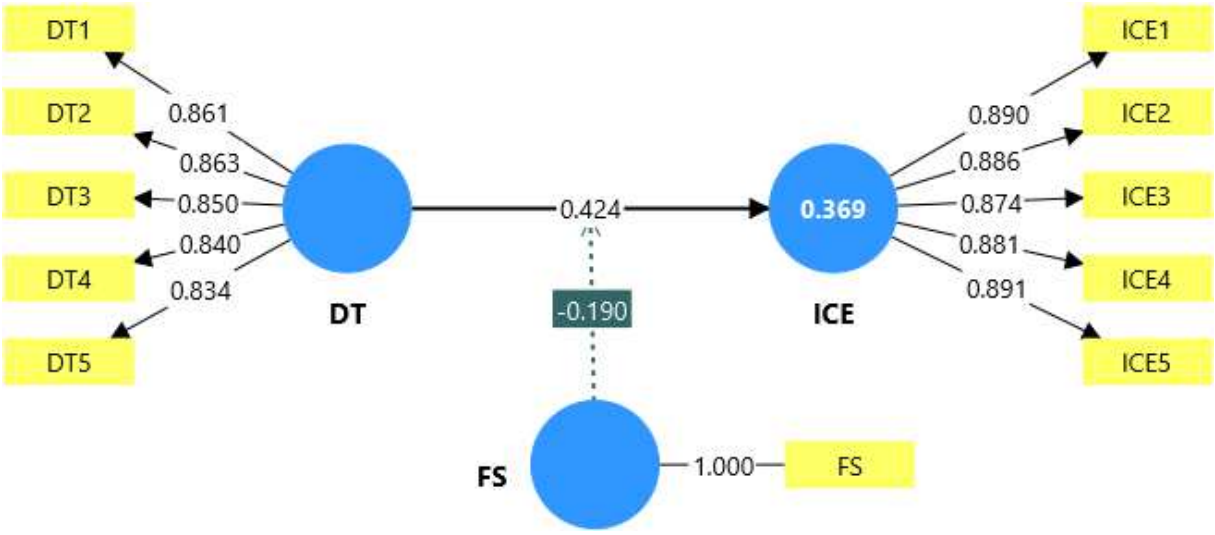

Figure 2. Results of the PLS-SEM structural equation model analysis

term exhibit small but meaningful effect sizes (f^2 = 0.109 and 0.052, respectively), based on the classifications by Cohen (2013). The hypotheses were tested using a bootstrapping procedure (5,000 resamples) to assess the statistical significance of the path coefficients. The results, summarized in Table 6, fully support the proposed research model. Hypothesis H1 is strongly supported, as Digital Transformation exerts a significant positive impact on internal control effectiveness (β = 0.424, t = 13.525, $p < 0.001$). This confirms the direct beneficial role of digitalization. Furthermore, Hypothesis H2, regarding the moderating role of firm size, is also supported with high statistical significance. The interaction term yields a negative path coefficient ($\beta = -0.190$, t = 4.837, $p < 0.001$).

To further elucidate the nature of the significant interaction effect found in H2, a simple slope analysis was conducted (see Figure 3).

The analysis reveals that the relationship between Digital Transformation and Internal Control Effectiveness remains positive across all firm sizes but varies in intensity (Table 7). The slope is steepest for small firms ($\beta \approx 0.614$), indicating that these enterprises experience the most rapid gains in internal control effectiveness when adopting digital tools. In contrast, the slope becomes notably flatter for large firms ($\beta \approx 0.234$). This confirms that while digitalization is beneficial for all, the marginal efficiency gains diminish as organizational scale and complexity grow. This empirical trend corroborates the findings of Li et al. (2018) regarding the agility of SMEs and aligns with the theoretical perspective of Yermack (1996) on organizational inertia, consistent with the antagonistic moderation effect observed. Finally, to assess the model's practical relevance beyond mere explanatory power, an out-of-sample predictive analysis was performed using PLS-predict. The results in

Table 5. Structural model results

Indicator	Value	Interpretation
R^2 (ICE)	0.369	Explains 36.9% of the variance in the dependent variable
f^2 (DT → ICE)	0.248	Medium effect
f^2 (FS → ICE)	0.109	Small effect
f^2 (FS × DT → ICE)	0.052	Small effect

Table 6. Summary of hypothesis testing

Hypothesis	Relationship	Path coefficient (β)	T-statistic	p-value
H1	DT → ICE	0.424	13.525	0.000
H2	FS x DT → ICE	–0.190	4.837	0.000

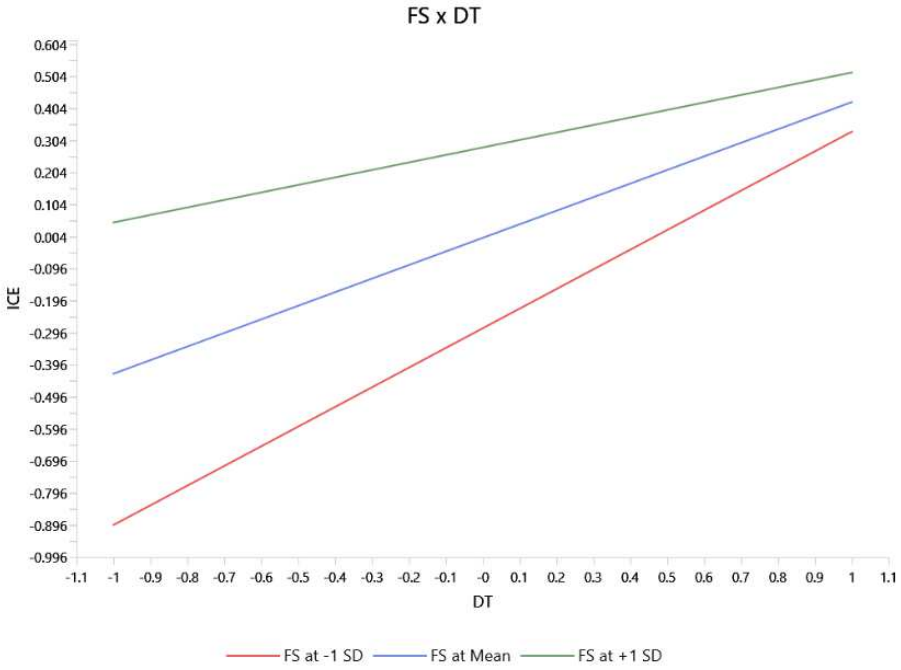

Figure 3. Simple slope analysis of the moderating effect of FS

Table 8 show that the Q^2_predict value for the dependent variable is 0.355, which is strictly greater than zero, meeting the criterion set by Shmueli et al. (2019) for satisfactory predictive relevance. Additionally, the prediction errors were analyzed using Root Mean Squared Error (RMSE = 0.810) and Mean Absolute Error (MAE = 0.597). The fact that the MAE is lower than the RMSE and both metrics are relatively low confirms that the model possesses a high degree of predictive accuracy and stability for forecasting internal control effectiveness.

4. DISCUSSION

The primary objective of this study was to empirically examine the impact of digital transformation on internal control effectiveness and to investigate the moderating role of firm size within the context of an emerging economy. The empirical results provide robust evidence supporting the transformative role of digital technologies while simultaneously illuminating the critical contingency effect of organizational scale. The finding that digital transformation exerts a substantial positive impact on internal control effectiveness (β = 0.424) corroborates recent scholarship regarding the digitalization of governance. This result aligns with the findings of Alhinai et al. (2025), who argued that digital tools fundamentally reconfigure the control environment by shifting from retrospective detection to real-time prediction. Similarly, the results support the empirical evidence provided by Ashraf (2025) and Obaydin et al. (2025), which demonstrated that the automation of workflows

Table 7. Interaction analysis (H2)

Firm Size	Effect of DT → ICE	Trend
Small (Low FS)	Strongest (Slope β ≈ 0.614)	High β, significant effectiveness
Large (High FS)	Weakest (Slope β ≈ 0.234)	Low β, reduced effectiveness

Table 8. Predictive power assessment for ICE

Indicator	Value
Q^2_predict	0.355
RMSE	0.810
MAE	0.597

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and the integration of artificial intelligence significantly reduce material weaknesses in internal control by minimizing human error and information asymmetry. However, unlike prior studies that often treated this relationship as linear and universal across developed economies, this research highlights that in the Vietnamese context, the efficacy of these tools is amplified by the specific need to overcome institutional voids and transparency deficits, effectively validating the Digital Audit–Control Integration model proposed in recent literature.

A more nuanced contribution of this study emerges from the analysis of the moderating role of firm size, which revealed a significant negative interaction effect ($\beta = -0.190$). This finding offers a critical counter-narrative to the traditional Resource-Based View, which posits that larger firms with superior financial and technological resources should theoretically derive greater benefits from digital investments (Tao et al., 2024). Instead, the results of this study diverge from that perspective and strongly support the structural inertia hypothesis proposed by Yermack (1996). The analysis indicates that while digitalization is beneficial for all enterprises, the marginal gains in internal control effectiveness diminish as organizational size increases.

This empirical trend is consistent with the findings of Chen et al. (2023), who observed that smaller firms possess an inherent technological adaptability, allowing them to integrate new control technologies into their operational fabric more rapidly and with lower coordination costs than their larger counterparts. In the specific context of Vietnam, large enterprises often grapple with complex, fragmented legacy systems and bureaucratic hierarchies that act as friction points, attenuating the immediate efficiency gains of digital solutions. Conversely, SMEs leverage their structural flexibility to implement cost-effective, cloud-based control systems that yield immediate improvements in governance quality.

From a theoretical perspective, these findings extend Contingency Theory into the digital domain by establishing firm size as a decisive boundary condition. The study demonstrates that the success of digital transformation in enhancing governance is not solely a function of technological investment but is contingent upon the organizational capacity to absorb and adapt to these changes. By integrating these insights, the research bridges the gap between the static COSO framework and dynamic digital capabilities, suggesting that internal control effectiveness in the digital era is a function of the alignment between technological sophistication and organizational agility. This challenges the universal approach often found in earlier literature and advocates for a size-contingent model of digital governance.

Practically, the study offers distinct implications for corporate managers and policymakers. For SME managers, the results underscore a strategic opportunity to leverage agility as a competitive advantage. Rather than emulating the complex infrastructure of large corporations, SMEs should adopt a targeted acceleration strategy, prioritizing high-impact technologies such as automated financial reporting and real-time data analytics to achieve superior internal control with minimal structural resistance. For executives in large enterprises, the findings serve as a cautionary note that resource abundance does not guarantee digital success. To overcome the diminishing returns of scale identified in this study, large firms must prioritize organizational restructuring – streamlining decision-making processes and dismantling information silos – as a prerequisite for technological deployment. Finally, for policymakers, the evidence supports the necessity of tailored support frameworks. Policies should recognize the distinct digital trajectories of different enterprise scales, focusing on providing accessible digital infrastructure for SMEs while encouraging large state-owned and multinational enterprises to modernize their legacy governance structures to fully realize the benefits of the national digital transformation agenda.

CONCLUSION

The primary objective of this study was to elucidate the mechanism through which digital transformation influences internal control effectiveness within an emerging economy context, specifically examining whether this relationship is contingent upon organizational scale. By analyzing empirical data from

452 Vietnamese enterprises, the research successfully addresses the gap in understanding how resource heterogeneity interacts with technological adoption to shape governance outcomes. The findings confirm that digital transformation acts as a critical driver for modernizing internal control systems, significantly enhancing risk assessment, information transparency, and operational compliance. However, this positive impact is not uniform; the study reveals a distinct inherent structural adaptability for small and medium-sized enterprises, whereas large corporations face diminishing marginal returns from digitalization due to structural inertia.

From these findings, several critical conclusions can be drawn. First, technology is no longer merely a support function but a foundational element of effective corporate governance in the digital era. The transition from manual to automated controls is essential for mitigating information asymmetry and agency costs. Second, organizational complexity represents a significant barrier to digital efficacy. Large enterprises cannot rely solely on financial muscle to achieve digital success; they must prioritize structural streamlining and process re-engineering to fully capitalize on digital investments. Conversely, the structural flexibility of smaller firms positions them uniquely to bypass intermediate traditional development stages by adopting cloud-based and automated governance solutions early on.

Despite its contributions, this study is not without limitations, which open avenues for future research. First, the cross-sectional design captures a snapshot of the digital transformation process but does not account for the dynamic evolution of internal control over time; longitudinal studies would be valuable in assessing the long-term sustainability of these digital benefits. Second, while the study focused on firm size, other contingency factors such as corporate culture, leadership style, or specific industry regulations were not explicitly modeled. Future inquiries should investigate how these variables interact with digital strategies to influence governance quality. Finally, as the digital landscape evolves rapidly, future research should explore the specific impact of emerging technologies like Blockchain and generative Artificial Intelligence on the next generation of internal control frameworks.

AUTHOR CONTRIBUTIONS

Conceptualization: Dao Manh Huy, Nguyen Thanh Tung.
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Formal analysis: Dao Manh Huy, Nguyen Thanh Tung.
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APPENDIX A

Table A1. Summary of measurement design

Variables	Description (Items) Adapted from		Sources
Digital Transformation (DT)	DT1	The application of IT in operations to improve efficiency	Davenport and Westerman (2018), Ross et al. (2017), Chui et al. (2016), Chen et al. (2012), Kane et al. (2015), Vial (2019)
	DT2	The tight integration of technology systems for data transparency	
	DT3	Workflow automation to reduce manual errors	
	DT4	The utilization of big data for decision-making	
	DT5	A long-term strategic orientation toward digitalization	
Internal Control Effectiveness (ICE)	ICE1	A systematic control process designed to ensure operational efficiency	COSO (2013), Arens et al. (2017), Jensen and Meckling (1976), DeFond and Zhang (2014), Kaplan and Norton (1996), Power (2007)
	ICE2	Strict adherence to regulations and compliance policies	
	ICE3	Capability to identify and mitigate risks effectively, empowered by control tools	
	ICE4	Timely information feedback for strategic decisions	
	ICE5	Continuous monitoring and improvement of the control system	

APPENDIX B. Research survey questionnaire

The impact of digital transformation on internal control effectiveness in Vietnamese enterprises

Dear Business Leaders/Sir/Madam,

We are currently conducting a research project titled "The Impact of Digital Transformation on Internal Control Effectiveness in Vietnamese Enterprises". We are committed to ensuring that all information provided by you will be kept strictly confidential and used solely for academic purposes.

We greatly appreciate your valuable support and contribution by taking a few minutes to complete this questionnaire.

I. General information

(Please mark (X) in the appropriate box or specify in the blank space)

Table B1. General information

No.	Criteria	Selection
1	Job Position	☐ Chief Financial Officer (CFO) ☐ Chief Accountant ☐ Head/Deputy Head of Internal Control
2	Educational Level	☐ Bachelor's Degree ☐ Master's Degree or higher
3	Work Experience	☐ 3 – 7 years ☐ 8 – 15 years ☐ > 15 years
4	Industry Sector	☐ Manufacturing & Industrial ☐ Services (Finance, Trade, Logistics) ☐ Information Technology & Telecommunications ☐ Other: .....
5	Enterprise Size	☐ Small (10 – < 50 employees) ☐ Medium (50 – < 250 employees) ☐ Large (≥ 250 employees)

II. Survey content

Please indicate your level of agreement with each of the following statements by marking (X) in the appropriate box on the 5-point Likert scale:

1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree

Table B2. Digital transformation (DT)

Code	Statements	1	2	3	4	5
DT1	Our enterprise has applied information technology into production and business operations.					
DT2	Technology systems within the enterprise are tightly integrated to ensure data connectivity and transparency.					
DT3	Work processes within the enterprise are highly automated.					
DT4	The enterprise utilizes big data to support decision-making.					
DT5	The enterprise has a specific long-term strategy for digital transformation.					

Table B3. Internal control effectiveness (ICE)

Code	Statements	1	2	3	4	5
ICE1	Internal control processes within the enterprise are clearly established and systematic.					
ICE2	The internal control system ensures compliance with legal and internal regulations.					
ICE3	Supported by effective tools, the control system helps detect and prevent financial, operational, and fraud risks.					
ICE4	Information from the internal control system is updated and provided to management in a timely manner.					
ICE5	The enterprise frequently monitors and improves the internal control system.					

III. Additional comments (If any)

If you have any other comments or suggestions regarding this research, please share them here:

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Sincerely thank you for your time and contribution!

The researcher may contact you for further discussion if necessary.

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