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Technological Innovation in Corporate Governance and Internal Audit Performance: The Moderating Role of Digital Skills and Knowledge of Internal Auditors among Ghanaian Listed Companies

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Technological Innovation in Corporate Governance and Internal Audit Performance: The Moderating Role of Digital Skills and Knowledge of Internal Auditors among Ghanaian Listed Companies

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Abstract

Purpose: This study aims to investigate the impact of technological innovations in corporate governance on internal audit performance, with a focus on the moderating role of digital skills and knowledge among internal auditors in Ghanaian listed companies.

Methodology: We employed an explanatory research design, using a mixed method approach. The data were collected from 300 principal officers of listed companies in Ghana, with a response rate of 74.3%. We utilised thematic analysis and Partial Least Squares Structural Equation Modelling (PLS-SEM) in XLSTAT for data analysis.

Findings: Technological innovations in corporate governance significantly improve internal audit performance in risk management, compliance, controls, and resource optimisation. The digital skills and knowledge of internal auditors positively influence this relationship, promoting the adoption of technology. While firms in Ghana derive benefits from technological innovations, blockchain and big data adoption remain limited by infrastructure gaps, skills shortages, and regulatory uncertainty.

Unique Contribution to Theory, Practice and Policy: We recommend that regulatory clarity be established through BoG, SEC, and ICAG frameworks on blockchain, AI, and cybersecurity, drawing lessons from South Africa, Kenya, and Nigeria. Professional bodies and universities should embed emerging technologies into training and curricula, while financing challenges are best addressed through public–private partnerships.

Keywords: *Corporate Governance, Technological Innovations, Internal Audit, Digital Skills, Risk and Compliance Management, Emerging Economies*

JEL Codes: *G34, O33, M42, J24, G32, O55, M42*

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INTRODUCTION

Technological advancement, heightened risks, complex operations, and rising stakeholder expectations increasingly characterise the global business environment. These dynamics demand innovations in corporate governance practices to safeguard performance and ensure long-term sustainability. However, persistent corporate failures worldwide highlight the consequences of weak governance structures. Marughu and Nwaobia (2020) argue that systemic governance deficiencies remain a leading cause of corporate collapse. Similarly, Nguyen (2011), drawing on the Enron scandal, noted that governance failures can erode public trust and destroy corporate value. This evidence demonstrates that poor governance leads to both systemic fragility and reputational crises, underscoring the importance of strengthening governance frameworks in the digital era. The Ghanaian context of corporate failure further revealed these vulnerabilities. This is because weak governance and risk management deficiencies were central to the collapse of several banks during the 2018 financial sector crisis (Agyemang et al., 2019; Torku & Laryea, 2021). Unlike global scandals rooted in managerial misconduct, these Ghanaian cases highlight a combination of regulatory lapses, weak board oversight, and inadequate internal audit practices. These crises not only destabilised the financial sector but also eroded stakeholder confidence, demonstrating the urgent need for governance mechanisms that are resilient and innovation-driven, especially in emerging economy contexts.

Globally, technological innovations, including artificial intelligence, robotic process automation, blockchain, cloud computing, the Internet of Things, and big data analytics, are reshaping corporate governance and internal auditing. Daidj (2022) shows how such technologies enhance transparency and internal controls, while Khan et al. (2023) and Vaidya et al. (2024) emphasise their role in enabling real-time risk management. In advanced economies, Betti et al. (2021) and Jezovita et al. (2024) argue that digital governance has shifted from being optional to becoming a strategic necessity. However, these findings largely reflect developed contexts with strong institutional frameworks and robust technological infrastructure.

Despite these advancements, two key gaps remain. First, most empirical studies on digital transformation in auditing are concentrated in developed economies (Affes & Jarboui, 2023; Schiavi et al., 2024), making it unclear how findings apply to emerging markets where institutional and cultural conditions differ. Second, within Africa, governance research has focused primarily on the causes of governance failures (Agyemang et al., 2019; Torku & Laryea, 2021), with limited empirical attention to how internal audit functions adapt to technological innovations. While Lois et al. (2020) and Amira and Abdelhafid (2023) highlight opportunities and risks of digital auditing, they do not test its influence on audit performance. Policy evidence further underscores this gap. The Bank of Ghana's e-Cedi design paper (2022) reflects a cautious, regulator-led approach to blockchain adoption, in contrast to Nigeria's earlier launch of the eNaira (Central Bank of Nigeria, 2021) and Kenya's enterprise-level deployments in digital finance (Garrett-Jones, 2023). The World Bank (2022) and the Milken Institute (2023) similarly note that Ghana's digital economy remains constrained by weak institutional frameworks, low investment, and limited digital capacity. These conditions raise critical questions about whether Corporate Governance Technological Innovations (CGTIs) can meaningfully enhance internal audit performance in resource-constrained settings such as Ghana.

Therefore, this study seeks to address these gaps by empirically examining how Corporate Governance Technological Innovations influence internal audit performance among listed companies in Ghana, and whether the digital skills and knowledge of internal auditors moderate this relationship. To achieve these objectives, we posed the following questions:

1. How do technological innovations in corporate governance influence internal audit performance among listed companies in Ghana?
2. Do digital skills and knowledge of internal auditors influence the adoption of Technological Innovation in the Corporate Governance System?
3. To what extent do the digital skills and knowledge of internal auditors moderate the relationship between governance innovations and audit performance?
4. What challenges do internal audit functions encounter in adapting to corporate governance technological innovations in Ghana's emerging economy setting?

By answering these questions, this study will contribute to Theory by extending the applicability of institutional Theory to weak institutional contexts, showing how governance innovations and internal audit functions adapt under regulatory uncertainty, limited infrastructure, and skill deficits. Empirically, it will provide rare evidence from an emerging economy, addressing the overconcentration of prior studies in developed markets. Practically, the findings will offer guidance for policymakers and regulators on digital audit adoption and capacity-building for internal auditors, while helping firms align governance innovations with the digital competencies of their audit teams. Beyond Ghana, the study will enrich global debates by demonstrating how digital transformation in corporate governance and auditing unfolds across diverse institutional environments.

LITERATURE REVIEW

This section is devoted to the theoretical framework, the empirical literature, and the hypothesis development.

Theoretical Review

This study draws on a complementary set of theories, Agency Theory, Dynamic Capabilities Theory, Institutional Theory, and the Technology Acceptance Model (TAM), to explain how corporate governance technological innovations (CGTIs) influence internal audit performance in Ghanaian listed companies. From an Agency Theory perspective, internal audit functions reduce information asymmetry by monitoring management and safeguarding shareholder interests (Jensen & Meckling, 1976). In the digital era, technological innovations such as blockchain and artificial intelligence enhance this monitoring role by ensuring data integrity and traceability (Khan et al., 2023). However, monitoring alone is insufficient unless auditors are also able to adapt to disruptive technologies. In this case, Dynamic Capabilities Theory (Teece et al., 1997; Helfat & Peteraf, 2009) complements agency logic by explaining how auditors must develop the capacity to sense emerging risks, seize opportunities, and reconfigure resources through tools like big data analytics and robotic process automation (Rakipi & D'Onza, 2024). The Agency Theory and Dynamic Capabilities Theory show that governance innovations not only reduce agency costs but also demand adaptive capabilities from internal auditors to sustain performance.

However, these organisational-level perspectives must be situated within the broader institutional environment. Institutional Theory (DiMaggio & Powell, 1983) posits that regulatory pressures, cultural norms, and professional expectations shape the adoption of digital auditing practices. While global regulatory bodies increasingly push for digital auditing standards (Schiavi et al., 2024), weak institutional frameworks in Ghana (Amira & Abdelhafid, 2023) constrain their legitimacy and pace of adoption. This is attributed to poor digital infrastructure and regulatory uncertainty in Ghana, as the Companies Act 2019 (Act 992), the Bank of Ghana, and the Ghana Stock Exchange have not provided a formalised framework to guide technological adoption in the country. The Institutional Theory, therefore, complements Agency and Dynamic Capabilities perspectives by emphasising that technological adoption is not merely a matter of firm choice, but also a function of regulatory credibility and institutional maturity.

Finally, even when governance innovations are institutionally mandated and organisationally feasible, their effectiveness depends on the willingness of internal auditors to use them. The Technology Acceptance Model (TAM) (Davis, 1989) explains this behavioural dimension. The internal auditors' perceptions of usefulness and ease of use determine whether technologies are embraced or resisted (Akter et al., 2024). TAM therefore links the structural and institutional dimensions of innovation with user-level acceptance, ensuring that CGTIs translate into improved internal audit performance.

In conclusion, these theories form an integrated framework with Agency Theory, which highlights the monitoring role of auditors; Dynamic Capabilities Theory explains their adaptability to technological change; Institutional Theory situates adoption within Ghana's weak regulatory environment; and TAM accounts for individual acceptance. Their complementarities provide a holistic explanation of how Corporate Governance Technological Innovations shape internal audit performance.

Empirical Literature and Hypotheses Development

Technological innovations are increasingly reshaping corporate governance systems, particularly in how oversight, accountability, and assurance functions are delivered. Traditional governance mechanisms are often deemed inadequate in an era of digitalisation, prompting the integration of Artificial Intelligence (AI), blockchain, robotic process automation (RPA), big data, and the Internet of Things (IoT) (Belloc, 2012; Daidj, 2022). These corporate governance technological innovations (CGTIs) enhance transparency, decision-making, and cost efficiency while minimising risks (Ranta et al., 2021; Raja, 2021). For example, blockchain improves audit traceability and data reliability (Khan et al., 2023; Jezovita et al., 2024), while AI and IoT facilitate real-time monitoring and predictive analytics (Sharma et al., 2021; Vaidya et al., 2024). Collectively, these technologies have the potential to transform corporate governance practices and strengthen internal audit functions.

Despite these benefits, the literature revealed important challenges. Technological adoption introduces new risks, including cybersecurity vulnerabilities, interoperability issues, and costly infrastructure demands (Lois et al., 2020; Rocha & Kissimoto, 2022). Blockchain, though enhancing transparency, complicates auditing as traditional sampling methods are less suitable for immutable, real-time records (Supriadi et al., 2020). Similarly, AI adoption requires specialised skills that are scarce in many emerging economies (Akter et al., 2024). Scholars also highlight that

technology-related risks, such as data security, scalability, and vendor dependence, demand adaptive audit methodologies and continuous auditor upskilling (White et al., 2020; Kahyyaoglun & Aksoy, 2021; Al-saedi & Almaliki, 2023). Thus, while CGTIs promise governance improvements, their realisation is uneven and context-specific, with developing economies like Ghana facing unique institutional and resource constraints.

The internal audit function, central to corporate governance, has itself undergone transformation. Beyond compliance, internal auditors now provide risk assurance, strengthen internal controls, and ensure efficient resource utilisation (IIA, 2020). Recent research positions internal auditors as strategic partners in value creation (Faiteh & Aasri, 2022; Mashayekhi et al., 2022). Strong governance structures are generally associated with more effective audits (Vadasi et al., 2020; Affes & Jarboui, 2023). However, the rapid pace of technological change complicates auditors' roles, as many lack competencies in areas such as blockchain validation, encryption assessment, or smart contract audits (Hashem et al., 2023). Big data analytics has been shown to enhance fraud detection and risk management (Cao et al., 2015). However, adoption remains constrained by high costs and limited expertise in emerging economies (Betti et al., 2021).

A recurring limitation in the literature is that studies often treat CGTIs and internal audit performance as separate domains, with evidence mainly drawn from advanced economies (Rodríguez-Espíndola et al., 2021; Toufaily et al., 2021). Few have examined how the integration of multiple governance technologies affects internal audit performance in developing contexts where digital maturity is limited. This represents a critical gap, given that the effectiveness of internal audit functions in such environments depends not only on governance structures but also on their ability to adapt to new technologies and emerging trends.

Theoretically, Agency Theory posits that effective governance mechanisms reduce information asymmetry by empowering auditors to enforce accountability (Jensen & Meckling, 1976). Dynamic Capabilities Theory further suggests that organisations enhance adaptability and resilience by embedding technological innovations into governance processes (Teece et al., 1997). The Technological Acceptance Model posits that the actual impact of technological innovation on audit performance within the corporate governance system depends on auditors' perceptions of its usefulness and ease of use (Davis, 1989; Akter et al., 2024). Empirical findings support these perspectives, showing that tools such as compliance platforms, blockchain, and big data analytics strengthen oversight, risk detection, and compliance monitoring (Bamberger, 2009; Thach et al., 2021; Zhu & Ahamat, 2023). At the same time, tensions arise because technology adoption also generates vulnerabilities, such as cybersecurity risks and skill shortages, that auditors must navigate (Rocha & Kissimoto, 2022; Khan et al., 2023).

Building on this evidence, we conceptualise CGTIs as comprising four key technological domains: Artificial Intelligence and Robotic Process Automation (AIRPA), Cloud Computing and the Internet of Things (CCIoT), Data Analytics and Big Data (DABD), and Blockchain Technology (BCT). These innovations are expected to shape internal audit performance across four critical dimensions: compliance management, risk management, internal controls, and resource management. Accordingly, the following hypotheses are proposed:

H1a: Artificial Intelligence and Robotic Process Automation (AIRPA) positively and significantly influence Internal Audit Performance

H1b: Cloud Computing and Internet of Things (CCIoT) positively and significantly influence Internal Audit Performance

H1c: Data Analytics and Big Data (DABD) have a positive and significant influence on Internal Audit Performance

H1d: Blockchain Technology (BCT) positively and significantly influences Internal Audit Performance

While technologies such as blockchain, AI, and big data analytics can enhance oversight, fraud detection, and control systems (Khan et al., 2023; Vaidya et al., 2024), their effectiveness is contingent upon internal auditors' ability to apply them in practice. The Technology Acceptance Model posits that perceived usefulness and ease of use influence adoption (Davis, 1989), suggesting that without adequate skills, internal auditors may resist or misapply technologies (Akter et al., 2024). Similarly, the Dynamic Capabilities Theory underscores that the ability to sense, seize, and reconfigure resources depends on individual and organisational competencies (Teece et al., 1997). Empirical studies support this view, showing that digital literacy enhances auditors' effectiveness in applying advanced analytics, improving fraud detection and risk management outcomes (Cao et al., 2015; Betti et al., 2021). Conversely, in contexts characterised by weak institutional support and scarce expertise, such as emerging economies, the benefits of CGTIs remain underutilised (Amira & Abdelhafid, 2023). Building on these insights, it is expected that digital skills and knowledge will positively moderate the relationship between CGTIs and internal audit performance, such that the benefits of governance innovations are amplified when auditors possess higher levels of digital competence. Based on the above theoretical and empirical context, the study hypothesises that:

H2: The digital skills and Knowledge of Internal Auditors positively influence the adoption of Corporate Governance Technological Innovations.

H3: Digital Skills and Knowledge of Internal Auditors positively moderate the relationship between Corporate Governance, Technological Innovations, and Internal Audit Performance

Conceptual Framework

The conceptual framework of this study provides a basis for analysing how technological innovations in corporate governance influence the effectiveness and efficiency of internal audit functions in meeting organisational goals. Figure 1 below presents the details.

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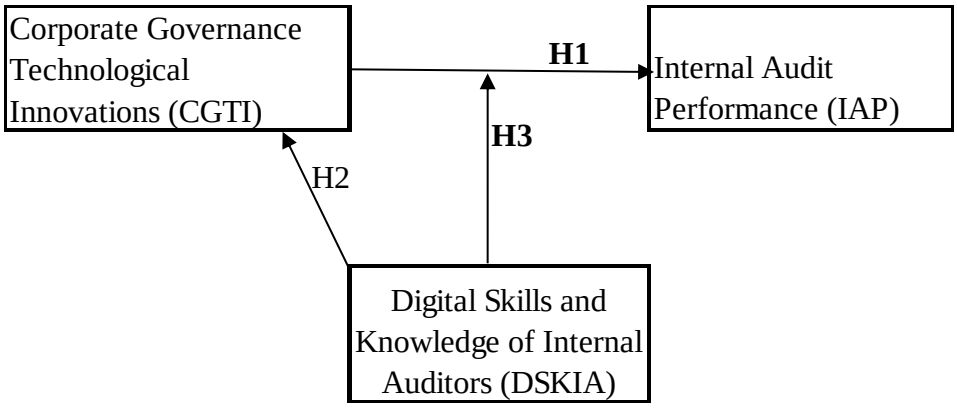

Figure 1: Conceptual Framework

From Figure 1, the conceptual framework is grounded in theoretical perspectives and derived from the gaps identified in existing literature on internal audit and governance innovations. While prior studies have addressed technological adoption in governance broadly (Daidj, 2022; Khan et al., 2023), few have investigated how internal audit functions, particularly in Africa, are restructured and reshaped by corporate governance technological innovations (CGTIs). This study contributes by integrating these theoretical insights to build a framework linking CGTIs to Internal Audit Performance (IAP) and how the digital skills and knowledge of the internal auditors influence the relationship/ Drawing from Institutional Theory, organisations adopt technologies in response to regulatory pressures, competitive forces, and stakeholder expectations (DiMaggio & Powell, 1983; Schiavi et al., 2024).

In operationalising CGTIs, this study focuses on Artificial Intelligence and Robotic Process Automation (AIRPA), Cloud Computing and the Internet of Things (CCIoT), Data Analytics and Big Data (DABD), and Blockchain Technology (BCT). These four domains were selected for two reasons. First, they represent the most widely discussed and empirically tested technologies in the governance and auditing literature (Cao et al., 2015; Khan et al., 2023; Rakipi & D'Onza, 2024). Second, they capture the dominant technologies currently being piloted or adopted by listed companies in Ghana, particularly in the banking, telecommunications, and energy sectors, where regulatory reforms and competition have accelerated digital transformation (Agyemang et al., 2019; Torku & Laryea, 2021). Other emerging domains, such as cloud security, cybersecurity tools, and regulatory technology (RegTech), are recognised as crucial for enhancing governance, particularly in advanced economies. However, adoption of these specialised technologies remains at an early stage in Ghana and is often embedded within broader digitalisation processes rather than pursued as stand-alone strategies (Rocha & Kissimoto, 2022; Amira & Abdelhafid, 2023). For example, cybersecurity measures are usually implemented as part of cloud or blockchain adoption, while RegTech applications are largely regulator-driven and not yet integrated at the firm level. By focusing on AIRPA, CCIoT, DABD, and BCT, this study offers a context-specific yet theoretically grounded examination of the most relevant governance innovations influencing internal audit practices among Ghanaian listed companies.

The internal audit performance is reflected through four key dimensions. Compliance Management Performance (CMP) refers to the ability of internal audit functions to ensure adherence to statutory requirements, corporate policies, and international standards, thereby reducing regulatory

violations and enhancing organisational accountability (Vadasi et al., 2020; Affes & Jarboui, 2023). Risk Management Performance (RMP) captures the extent to which internal auditors identify, assess, and mitigate organisational risks, providing assurance on governance resilience and protecting shareholder value (Faiteh & Aasri, 2022; Mashayekhi et al., 2022). Internal Control Systems (ICS) represent the effectiveness of audit mechanisms in evaluating and strengthening processes designed to safeguard assets, prevent fraud, and ensure reliable financial reporting, consistent with the Institute of Internal Auditors' (IIA, 2020) emphasis on strong controls as the foundation of governance. Finally, Internal Resource Management Performance (IRMP) reflects the contribution of internal auditing to the efficient use and optimisation of organisational resources, including financial, technological, and human capital, ensuring they are strategically aligned to support value creation (Hashem et al., 2023; Rakipi & D'Onza, 2024).

The application of these technologies depends on the level of digital skills and knowledge of the internal auditors. According to Davis (1989), the perceived usefulness and ease of use influence technological adoption, suggesting that without adequate skills, internal auditors may resist or misapply technologies (Akter et al., 2024). This assertion has two dimensions. First, the digital skills and knowledge of internal auditors equip them to serve as strategic advisors, guiding management in selecting and adopting the most appropriate governance technologies. Second, these same competencies enable auditors to directly apply such technologies in their assurance and advisory functions, thereby enhancing the effectiveness and overall performance of the internal audit function.

METHODOLOGY

This study investigates the impact of corporate governance technological innovations on the performance of internal audit functions among companies listed on the Ghana Stock Exchange (GSE). To achieve this, an explanatory research design was employed, as it is most appropriate for establishing causal relationships between predictor variables (corporate governance technological innovations) and outcome variables (internal audit performance) (Babbie, 2016). The study targeted all firms listed on the GSE as of December 31, 2023 (37 in total). We selected 30 companies using a stratified and proportionate sampling method. A purposive sampling technique was then employed to select 10 key principal officers, resulting in a sample size of 300 respondents. Quantitative data from the questionnaire were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) in XLSTAT. This technique was chosen due to its suitability for complex models with formative and reflective constructs, as is typical in RBV-based models (Hair et al., 2021). Qualitative data were examined through thematic analysis.

The structured questionnaire was developed using validated items adapted from prior empirical studies to ensure reliability, validity, and comparability with existing literature. Responses were measured on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). For Corporate Governance Technological Innovations (CGTIs), items on Artificial Intelligence and Robotic Process Automation (AIRPA) were adapted from Vaidya et al. (2024) and Sharma et al. (2021) to capture automation, fraud detection, and efficiency in audit processes; Cloud Computing and the Internet of Things (CCIoT) were based on Ranta et al. (2021), focusing on scalability, accessibility, and data-sharing capabilities; Data Analytics and Big Data (DABD) were adopted from Khan et al. (2023) and Hashem et al. (2023), emphasising predictive insights, anomaly detection, and

decision-making. Blockchain Technology (BCT) items were drawn from Supriadi et al. (2020) and Toufaily et al. (2021), reflecting transparency, immutability, and audit trail integrity. For Internal Audit Performance (IAP), Compliance Management Performance (CMP) was measured using items from Bamberger (2009) and Zhu & Ahamat (2023), focusing on regulatory adherence and policy compliance; Risk Management Performance (RMP) was based on Rodríguez-Espíndola et al. (2021) and Affes & Jarboui (2023), covering the audit function's role in risk identification, assessment, and mitigation; Internal Control System (ICS) items, adapted from Thach et al. (2021) and Vadasi et al. (2020), assessed the reliability of financial reporting, policy enforcement, and fraud prevention; while Internal Resource Management Performance (IRMP), drawn from Teece et al. (1997) and Helfat & Peteraf (2009), evaluated the internal audit's contribution to efficient resource allocation, cost optimisation, and process improvement. After developing the questionnaire based on prior studies, it underwent expert review to refine the wording of the items. A pre-test with 10 firms was conducted, yielding a Cronbach's α of 0.76, which confirms acceptable reliability.

RESULTS AND DISCUSSION

Measurement Model Evaluation

This section assesses the construct reliability and validity to ensure internal consistency of the variables. Table 1 below presents the details.

Table 1: Construct Reliability and Validity

Construct	Dimensions	Cronbach's Alpha	D.G. rho (PCA)	AVE	Eigenvalues	Condition Number
DSKIA (Digital Skills & Knowledge)	1					
CGTI (Corporate Governance Tech. Innovations)	4	0.754	0.845	0.570	2.311; 0.691; 0.588; 0.410	2.375
DSKIA & CGTI (Interaction Term)	4	0.937	0.955	0.842	3.368; 0.262; 0.204; 0.167	4.493
IAP (Internal Audit Performance)	4	0.722	0.834	0.584	2.351; 0.970; 0.383; 0.296	2.82

According to Table 1, the reliability analysis, as indicated by Cronbach's Alpha values ranging from 0.722 to 0.937, demonstrates that the variables are reliable. Multicollinearity statistics, such as Tolerance and Variance Inflation Factor (VIF), were also examined to evaluate the level of

correlation among predictor variables and to ensure the stability and interpretability of regression coefficients. All condition numbers are below the critical threshold of 10, indicating no multicollinearity issues in the measurement model. The Average Variance Extracted (AVE) values exceed the 0.50 benchmark (CGTI = 0.570, DSKIA&CGTI = 0.842, IAP = 0.584), confirming convergent validity. Therefore, the variables do not compromise the model's interpretability. This statistical evidence supports the inclusion of the variables in the regression model, as their contributions appear independent and do not lead to redundancy.

Structural Model Evaluation

The researchers performed an analysis of cross-loadings and evaluated the model's explanatory power to assess its robustness. The detailed results of these evaluations are presented in Tables 2 and 3.

Table 2: Cross-loadings (Monofactorial Manifest Variables)

	CGTI	IAP	DSKIA	DSKIA & CGTI
AIRPA	**0.791**	0.417	0.426	0.614
BCT	**0.774**	0.483	0.342	0.600
CCToT	**0.726**	0.402	0.371	0.581
DABD	**0.728**	0.455	0.320	0.535
IRMP	0.230	**0.353**	0.311	0.326
RMP	0.506	**0.868**	0.471	0.549
ICS	0.482	**0.860**	0.473	0.528
CMP	0.474	**0.848**	0.426	0.503
LCCA	0.491	0.559	**1.000**	0.908
AIRPA*DSKIA	0.724	0.541	0.833	**0.903**
BCT*DSKIA	0.723	0.603	0.806	**0.928**
CCIoT*DSKIA	0.694	0.577	0.825	**0.908**
DABD*DSKIA	0.697	0.613	0.869	**0.931**

Table 3: Model Fit and Predictive Power

R^2 (IAP / 1):

R^2	R^2 (Bootstrap)	Standard error	Critical ratio (CR)	Lower bound (95%)	Upper bound (95%)
0.426	0.437	0.059	7.244	0.333	0.547

The cross-loading analysis in Table 2 confirms that CGTIs are well-represented by four core technologies (AIRPA, BCT, CCIoT, DABD), and risk management, internal controls, and compliance strongly shape internal audit performance. While digital skills (DSKIA) exhibit a modest stand-alone influence, their interaction with CGTIs yields very high loadings, indicating that digital competencies significantly enhance the effectiveness of governance technologies.

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Statistical evidence from Table 3 indicates that the structural model accounts for a substantial portion of the variance in Internal Audit Performance (IAP), with an R^2 value of 0.426. The bootstrapped estimate (0.437) closely aligns with the observed value, supported by a low standard error (0.059) and a critical ratio of 7.244, indicating statistical significance. The 95% confidence interval (0.333–0.547) further confirms the stability of the estimate. Following Chin's (1998) guidelines, this R^2 reflects moderate explanatory power, suggesting that Corporate Governance Technological Innovations (CGTIs) and the digital skills of internal auditors collectively account for a meaningful proportion of the variance in IAP. These findings provide strong empirical support for the hypothesised relationships (H1–H3), reinforcing the argument that technological adoption, when complemented by auditor competencies, significantly enhances internal audit effectiveness in Ghanaian listed firms.

Hypothesis Testing and Results

The final stage of the model focused on the moderating role of digital skills and knowledge of internal auditors on the relationship between the impact of corporate governance technological innovations and internal audit performance. The statistical evidence is presented in Table 4 and Figure 2 below.

Table 4: Structure Model Test

Latent variable	Value	Value (Bootstrap)	Standard error (Bootstrap)	Critical ratio (CR)	Lower bound (95%)	Upper bound (95%)
LCCA	0.227	0.227	0.018	12.489	0.192	0.265
CGTI	0.234	0.239	0.019	12.208	0.200	0.281
DSKIA & CGTI	0.259	0.261	0.018	14.255	0.223	0.295

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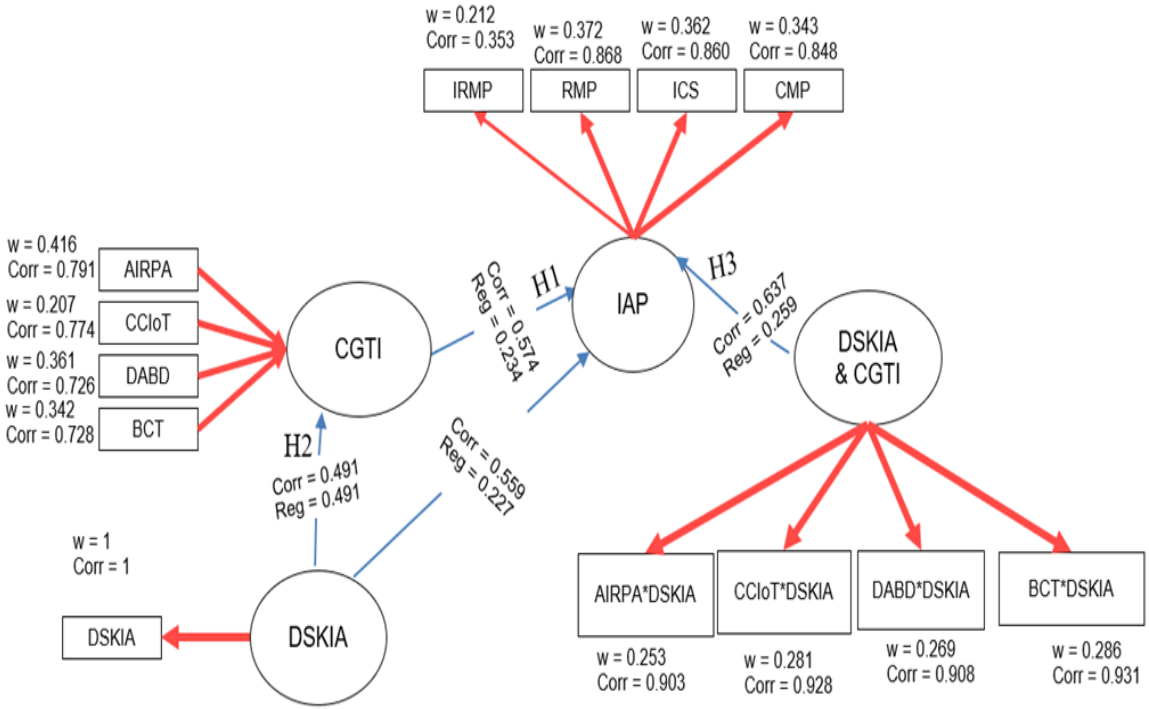

Figure 2: PLS Path Coefficient

The structural model results from Figure 2 and Table 4 demonstrate that corporate governance technological innovations (CGTIs) have a significant and positive effect on internal audit performance (IAP). The path coefficient was 0.234 (*Bootstrap* = 0.239, *SE* = 0.019, *CR* = 12.208, 95% *CI* [0.200–0.281]), exceeding the critical ratio threshold of 1.96. This provides strong support for Hypothesis 1, which posited that CGTIs positively influence IAP. These values indicate that the overall impact of CGTIs on IAP is strong, stable, and statistically significant. The finding aligns with Khan et al. (2023), who argued that innovations such as AI, blockchain, and big data reduce information asymmetry and enhance audit transparency (Khan et al., 2023). It is also consistent with Dynamic Capabilities Theory (Teece et al., 1997), indicating that audit units adapt by deploying advanced technologies to strengthen compliance, risk management, and internal controls. Empirically, these results reinforce earlier evidence that digital tools enhance fraud detection, oversight, and resource optimisation (Cao et al., 2015; Betti et al., 2021), though the effect in Ghana reflects contextual challenges such as infrastructure and skill limitations (Amira & Abdelhafid, 2023). AIRPA, CCIoT, DABD, and BCT each contribute significantly to internal audit performance. In terms of relative contributions, AIRPA exhibits the strongest weight (0.416), followed by CCIoT (0.361), DABD (0.342) and BCT (0.207). This ranking suggests that companies in Ghana that incorporate AI and RPA, along with blockchain systems, gain greater benefits in risk management, compliance, resource optimisation, and control systems.

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Regarding Hypothesis 2, the results confirm that Digital Skills and Knowledge of Internal Auditors (DSKIA) significantly and positively influence the adoption of CGTIs. The path coefficient was 0.227 (*Bootstrap* = 0.227, *SE* = 0.018, *CR* = 12.489, 95% *CI* [0.192–0.265]), showing a robust effect. This supports the view that internal auditors with strong digital literacy act as both strategic advisors guiding management on which technologies to adopt and as practitioners who can directly apply these tools to improve assurance quality. This outcome is consistent with the Technology Acceptance Model (Davis, 1989), which highlights perceived usefulness and ease of use as critical to adoption, and with the Resource-Based View, which positions human capital as a valuable, rare, and non-substitutable capability. In line with empirical studies (Akter et al., 2024; Rakipi & D'Onza, 2024), the evidence suggests that firms in Ghana with digitally skilled auditors are better equipped to integrate technologies such as AI, IoT, and blockchain into their governance processes, thereby enhancing audit effectiveness.

To assess the moderating effect of digital skills and knowledge of internal auditors on the relationship between corporate governance, technological innovation, and internal audit performance, we conducted the interaction analysis to identify the direct, indirect, and total effects. See Table 5 below for details.

Table 5: Moderation Effect

Path (From → To)	Direct Effect	Indirect Effect	Total Effect	Boot-strapped Effect	Std. Error (Bootstrap)	95% CI (Lower–Upper)
DSKIA → CGTI	0.491		0.491	0.501	0.057	0.364 – 0.634
DSKIA → IAP	0.227	0.115	0.342	0.347	0.028	0.294 – 0.404
CGTI → IAP	0.234		0.234	0.239	0.019	0.200 – 0.281
DSKIA × CGTI → IAP	0.259		0.259	0.261	0.018	0.223 – 0.295

As shown in Table 6, digital skills and knowledge of internal auditors (DSKIA) had a significant positive effect on CGTIs (β = 0.491, $p < 0.01$) and also influenced IAP both directly (β = 0.227) and indirectly (β = 0.115) through CGTIs, resulting in a strong total effect (β = 0.342). CGTIs themselves significantly enhanced IAP (β = 0.234), while the interaction term (DSKIA × CGTI) further strengthened the relationship (β = 0.259), confirming the hypothesised moderating effect (H3). This finding provides empirical support for the Dynamic Capabilities Theory (Teece et al., 1997), which emphasises the ability of organisations to sense, seize, and reconfigure resources in turbulent environments. While CGTIs provide the tools, it is the auditors' digital capacity that determines whether these innovations translate into measurable internal audit performance improvements. This is particularly critical in Ghana, where firms face disruptions such as high implementation costs, cybersecurity risks, and scarce expertise. By moderating the CGTI–IAP relationship, digital skills act as a catalyst that enables auditors to overcome these barriers and extract greater value from technological innovations

Discussion

The findings reaffirm that technological innovations in corporate governance reshape internal audit performance in Ghanaian listed firms, though in ways conditioned by contextual realities. In line

with Agency Theory (Jensen & Meckling, 1976), AIRPA and blockchain play a vital role in reducing information asymmetry. By generating transparent and immutable audit trails, these technologies allow internal auditors to verify transactions independently, even in a regulatory environment where national oversight is relatively weak. For example, one internal auditor noted, "*Blockchain helps us close the gap where regulators are slow; we can independently verify records without waiting for external enforcement*." This demonstrates how governance technologies operationalise Agency Theory in Ghana's context by reducing managerial opportunism and strengthening accountability despite institutional deficiencies.

The results also align with Dynamic Capabilities Theory (Teece et al., 1997; Helfat & Peteraf, 2009). Internal audit units in Ghana demonstrated adaptability by utilising CCIoT and big data to sense risks and reconfigure processes. Compared to other emerging markets such as Nigeria and Kenya, where IoT-driven compliance dashboards are increasingly embedded in financial reporting systems, Ghanaian firms are still in the early stages of operationalising these tools. One respondent emphasised, "*Our use of IoT is still basic; we rely on it mainly for compliance checks, not for predictive analytics like some of our peers in Nigeria*." This comparative evidence highlights that Ghana's trajectory mirrors broader regional trends but lags in sophistication.

The moderate impact of Data Analytics and Big Data (DABD) requires careful interpretation. While novelty partly explains the results, many Ghanaian firms are only beginning to pilot analytics systems; contextual constraints are also decisive. High implementation costs, limited in-house expertise, and weak IT infrastructure reduce the perceived ease of use and usefulness of DABD. One internal auditor explained, "*We know data analytics can help us detect fraud earlier, but our systems cannot handle large datasets coupled with limited expertise in the auditing of the IT environment.*" This echoes TAM's insights (Davis, 1989; Akter et al., 2024) that adoption is not only about availability but also perceptions of usability and resource feasibility.

From an Institutional Theory perspective (DiMaggio & Powell, 1983), the adoption of CGTIs illustrates how global regulatory and professional pressures are influencing Ghanaian governance practices. While advanced economies are already mandating blockchain and AI-based audit systems (Schiavi et al., 2024), Ghanaian auditors remain constrained by weak institutional frameworks. As some respondents noted, "*In the absence of specific guidelines, we frequently find ourselves uncertain about which regulatory standards are relevant to these new technologies*." However, one interviewee noted, "*Even without strong national standards, we are feeling the pressure from investors and multinationals to upgrade our technologies*." This shows that external pressures, rather than domestic regulation, are driving much of the digital governance transformation.

Internal auditors were not merely users but also advisors, guiding firms on resource prioritisation. In resource-constrained environments like Ghana, auditors influenced management to allocate scarce capital toward high-impact technologies such as AI and blockchain. This advisory role strengthens their strategic positioning within the governance system and aligns with the Institute of Internal Auditors' emphasis on consultative value creation.

Blockchain adoption in Ghana remains comparatively low relative to other emerging economies. Interviews reveal that uptake is concentrated within the finance and insurance sectors, where regulatory oversight and the need for secure, transparent transactions have fostered

experimentation. For instance, Ghana's Blockchain engagements, primarily the Bank of Ghana's Design Paper of the e-Cedi (BoG, 2022) and limited CBDC pilot projects, are largely regulator-led. In contrast, Nigeria benefits from a vibrant private-sector–driven blockchain ecosystem, supported by fintech startups and crypto-friendly innovation hubs (Central Bank of Nigeria, 2021), while Kenya demonstrates notable enterprise-level blockchain use cases in sectors such as mobile payments and supply chain finance (Milken Institute, 2023). This divergence reflects Ghana's cautious regulatory stance and capacity constraints, including gaps in technical infrastructure and human capital, which have thwarted broader adoption. As a result, Ghanaian firms tend to prioritise technologies offering more immediate compliance and operational benefits, leaving the integration of blockchain in corporate governance adoptions to evolve more slowly within state-backed initiatives.

To ensure the effective adoption of governance technologies, our interviews highlighted the distinct responsibilities of key stakeholders. Regulators such as the Bank of Ghana and the Securities and Exchange Commission must provide regulatory clarity and enforce digital audit standards. Professional bodies like ICAG and IIA Ghana should translate these frameworks into specialised training, certifications, and continuous professional development. Meanwhile, corporate boards and audit committees hold the responsibility for allocating resources, embedding cybersecurity protocols, and ensuring that digital adoption aligns with strategic governance objectives.

Overall, the combined effect of AIRPA, BCT, CCIoT, and DABD significantly enhances internal audit performance, though the relative contributions vary. Unlike prior studies from developed economies (Rodríguez-Espíndola et al., 2021; Toufaily et al., 2021; Daidj, 2022), this study demonstrates that even in resource-limited settings, firms incorporating governance technologies improve risk management, compliance, controls, and resource optimisation. However, gaps persist, especially regarding blockchain and big data, where investment in infrastructure, training, and institutional frameworks is crucial to realise the benefits of digital auditing in Ghana fully.

Challenges Associated with Technological Innovation in the Corporate Governance System

The study also explored the challenges that internal auditors face in the technological auditing environment. To gain an in-depth understanding of these challenges, internal auditors and independent auditors were interviewed, and the interview results were thematically analysed. Table 6 below presents the details.

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Table 6: Challenges Associated with Technological Innovation in the Corporate Governance System

Theme	Description	Illustrative Quotes	Implications for Internal Audit
Skills Gaps and Training Needs	Auditors lack adequate knowledge of digital tools (AI, blockchain, big data, cloud systems). Traditional training is insufficient.	*"The pace of technological change is faster than the speed at which we can acquire relevant skills."*	Continuous professional development is necessary to equip auditors with the digital competencies they need.
Cybersecurity and Data Privacy Risks	Adoption of digital platforms increases exposure to breaches and privacy risks. Auditors often lack cybersecurity expertise.	*"When we perform audits on digital systems, it becomes significantly more challenging to ensure data security and protect client confidentiality."*	Auditors' scope must expand to include cybersecurity evaluation and privacy assurance.
Resistance to Technological Change	Employees and managers are reluctant to adopt innovations due to fear of job loss or discomfort with change; auditors face restricted access.	*"Management perceives these technologies as a threat instead of a resource."*	Cultural resistance undermines effective integration of digital tools. Internal auditors may be forced to rely on output reviews rather than process audits, which can limit assurance quality. Without leadership support, auditors cannot access full systems, weakening their ability to test internal controls and evaluate risks.
Regulatory Uncertainty	There is a lack of clear national frameworks for auditing technologies such as AI and blockchain. Standards are evolving and inconsistent.	*"In the absence of specific guidelines, we frequently find ourselves uncertain about which regulatory standards are relevant to these new technologies."*	Regulatory clarity is required to reduce uncertainty and enhance compliance assurance.

Following the thematic analysis, the challenges identified can be interpreted through the study's theoretical framework. The skills gap resonates with the Technology Acceptance Model (Davis, 1989), which stresses that even when innovations are perceived as applicable, limited ease of use and lack of expertise constrain adoption. Cybersecurity and data privacy risks align with Agency Theory (Jensen & Meckling, 1976), since weak controls and uncertain audit capacity heighten information asymmetry between principals and agents. The resistance to technological change supports insights from Dynamic Capabilities Theory (Teece et al., 1997), as organisations unable to reconfigure resources and overcome cultural inertia struggle to adapt effectively. Finally, the regulatory uncertainty theme reflects Institutional Theory (DiMaggio & Powell, 1983), highlighting how the absence of formalised standards in Ghana undermines legitimacy and constrains audit innovation. Together, these findings also draw on Resource Dependence Theory (Pfeffer & Salancik, 1978), showing that firms must secure and deploy digital resources strategically if auditors are to remain effective.

Conclusions and Policy Recommendations

This study confirms the transformative role of technological innovations, including artificial intelligence (AI), robotic process automation (RPA), blockchain, cloud computing, the Internet of Things (IoT), and big data analytics, in strengthening corporate governance and enhancing internal audit functions in Ghana. The findings show that these technologies enhance audit accuracy, reinforce internal controls, and boost risk management, with AI and RPA emerging as particularly influential through efficient data analysis and real-time monitoring. Blockchain further improves transparency and audit reliability by ensuring data immutability. However, adoption remains limited by skills gaps, cybersecurity risks, regulatory uncertainty, organisational resistance, and high implementation costs. These findings expand theoretical understanding by illustrating how digital auditing depends on contextual factors such as institutional frameworks, resource constraints, and human capital, which are especially significant in emerging markets like Ghana.

Policy Implications and Recommendations

The study highlights the need for coordinated reforms to facilitate the effective adoption of governance technologies in Ghana. Based on the conclusion of the study, we recommend the following:

1. The Bank of Ghana (BoG), the Securities and Exchange Commission (SEC), and the Institute of Chartered Accountants in Ghana (ICAG) should collaborate to develop clear standards to regulate technological innovations in corporate governance, particularly blockchain, AI, and cybersecurity. This will reduce uncertainty, build investor confidence, and standardise digital auditing practices. Lessons can be drawn from the South African Reserve Bank's fintech guidelines and the Nigerian SEC's (2022) digital asset framework, both of which provided clarity and accelerated adoption.
2. Once regulatory clarity is achieved, capacity building is necessary. Professional bodies (ICAG, IIA Ghana) in partnership with the universities in Ghana should design curricula on AI auditing, blockchain assurance, and data analytics, while ensuring Continuous Professional Development (CPD) requirements explicitly cover emerging technologies.

3. To address cost barriers, the Ministry of Finance and the Ministry of Communications and Digitalisation should promote Public–Private Partnerships (PPPs) financing agreements, offering tax incentives, shared service centres, and subsidised cloud platforms to reduce the financial burden on listed firms. Kenya's M-Pesa partnerships demonstrate how PPPs can diffuse digital solutions efficiently.
4. Boards and audit committees should embed robust data protection protocols (encryption, multi-factor authentication, penetration testing) and foster a culture that views technology as an enabler. Change management programs and employee awareness campaigns are essential. The King IV Code in South Africa, which integrates IT risk oversight into governance, provides a model for Ghanaian boards.

Originality of the Study

To the best of our knowledge, this research is the first in Ghana to examine how technological innovation in the Corporate Governance System influences internal audit performance, placing it among the few studies globally that explore this emerging area.

Limitation of the Study

Even though our dimensions capture the governance innovations most relevant to Ghana's listed companies, they reflect both global trends in technological innovations and local priorities. This focus limits the study's scope, as it does not consider other potentially important technologies such as cybersecurity, RegTech, or advanced machine learning applications in fraud analytics. Future research should broaden the framework to incorporate these additional dimensions, offering a more comprehensive picture of how diverse digital tools shape internal audit performance in emerging-market contexts.

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