

## Leveraging Technology-Driven Audits to Enhance Public Procurement Good Governance in Namibia

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### ABSTRACT

Public procurement has remained a central instrument for achieving transparency, accountability, and value for money in government operations. Despite an extensive regulatory framework, Namibia's public procurement system continued to face persistent governance challenges. These challenges were primarily due to reliance on conventional procurement audit practices, which limited effective oversight, delayed the detection of procurement irregularities, and weakened audit traceability in public sector supply chains. Objectives: This study aimed to examine the role of technology-driven audits in enhancing public procurement governance in Namibia. The study focused on assessing how digital audit systems influenced audit integration, transparency, oversight effectiveness, and risk management within public sector procurement processes. Method: A descriptive mixed-methods research design was employed. Quantitative data were collected from 332 procurement and audit professionals using a structured online questionnaire and analysed using SPSS through descriptive statistics and regression analysis. Results: The findings indicated that technology-driven procurement audits significantly enhanced digital audit integration, improved data transparency, strengthened oversight effectiveness, and supported more proactive risk management. However, implementation was constrained by inadequate ICT infrastructure, limited digital competencies and technical capacity, budgetary constraints, and institutional resistance to change. Conclusion: The study concluded that technology-driven audits represented a viable mechanism for improving procurement governance outcomes in the public sector, provided that institutional preparedness, sustained funding, and capacity development were adequately addressed.

**Contribution:** This study filled an empirical gap by providing mixed-methods evidence on the governance implications of technology-driven audits in public procurement within a developing-country context, offering insights relevant to procurement and supply chain management practices and policies.

**Keywords:** Technology-driven audits, public procurement, good governance, Namibia.

### INTRODUCTION

Public procurement plays a central role in public sector supply chains, enabling governments to acquire the goods, services, and infrastructure necessary for socio-economic development. At the global level, public procurement accounts for approximately 12–20% of national gross domestic product (GDP), making it a significant instrument for driving economic growth, ensuring fiscal sustainability, and enhancing public service delivery (OECD, 2021; World Bank, 2024). Given the scale of public expenditure involved, procurement governance is crucial to ensuring transparency, accountability, and value for money. When governance mechanisms

are weak, procurement systems are more vulnerable to inefficiencies, misuse of public resources, and declining public confidence, particularly in developing economies (Kakwezi & Nyeko, 2023).

Across the African region, governments have increasingly pursued digital transformation initiatives to improve procurement efficiency and strengthen oversight through technology-driven systems such as electronic government procurement (e-GP) platforms. Countries such as Kenya, Rwanda, and South Africa have introduced regulatory frameworks designed to support transparent procurement processes, effective contract management, and enhanced accountability (World Bank, 2024; African Development Bank, 2024). Despite these efforts, many public institutions have struggled to fully implement digital procurement systems due to organisational limitations, technical constraints, and institutional resistance to change (Mandala, 2024; Eric & Dadzie, 2019). In contrast, private sector organisations across the continent have demonstrated greater flexibility in adopting Industry 4.0 technologies to optimise procurement operations and strengthen internal controls. This divergence has prompted calls for public sector institutions to adapt more rapidly to technological innovations to remain effective and responsive to service delivery demands (Mokhtar et al., 2024).

In Namibia, public procurement accounts for more than 25% of national GDP, underscoring its strategic importance for national development and public sector performance (World Bank, 2024). In response to global and regional reform trends, Namibia enacted the Public Procurement Act 2015 (Act No. 15 of 2015). It introduced an electronic government procurement (e-GP) system to strengthen procurement governance (Asheela-Shikalepo & Warikandwa, 2021). Section 2(a) of the Act reinforces the objectives of the procurement system by mandating key principles, namely integrity, accountability, transparency, competitive supply, effectiveness, efficiency, fair dealing, responsiveness, informed decision-making, consistency, legality, and integration in the procurement of goods, works, and services (Government Gazette, 2017). Together, these principles form the normative foundation for good governance in procurement in Namibia, providing a benchmark against which procurement practices, audit mechanisms, and oversight effectiveness are assessed. The e-GP system was introduced to support these principles by improving access to procurement information, enhancing compliance, and promoting value-for-money and socio-economic development objectives (Maepa, 2023).

Despite these reforms, Namibia's public procurement system continues to experience operational and structural challenges. Oversight reports and sector analyses have highlighted inadequate accountability mechanisms, limited leadership support, fragmented procurement practices, and delays in audit processes as persistent weaknesses that constrain the effectiveness of procurement and service delivery (Office of the Auditor-General, 2023; Mandala et al., 2024). Although public investment in information and communication technology (ICT) has increased, these investments have not adequately addressed the fragmentation of digital systems or the absence of integrated data management capabilities. As a result, procurement entities continue to face limited audit traceability, weak interoperability across systems, and restricted real-time oversight. These conditions reflect broader regional experiences, indicating that digitalisation of procurement alone is insufficient without corresponding improvements in audit and oversight arrangements.

From a scientific perspective, growing attention has been focused on the role of digital technologies in enhancing procurement governance and improving supply chain performance. Digital procurement platforms, automated reporting tools, and data analytics have been associated with enhanced transparency, improved compliance, and more informed decision-making within public procurement systems (Muriuki, 2023; Castka et al., 2023). Within the auditing domain, technology-driven approaches have been linked to improved audit coverage, greater accuracy, and more timely oversight through automation, continuous auditing, and integrated data analysis (Oluoch, 2022; Otia & Bracci, 2022). Advances in big data analytics, blockchain technology, and the Internet of Things have further expanded opportunities for real-time monitoring, predictive risk assessment, and responsive audit interventions (Abdullah & Almaqtari, 2024).

However, existing literature has broadly examined procurement systems and auditing practices as separate areas of inquiry, with limited empirical attention given to technology-driven procurement audits as an integrated governance mechanism. Additionally, evidence from developing-country contexts, particularly in Southern Africa, remains limited. While digital transformation in public sector governance has been widely discussed (Alhabatah et al., 2023), few studies have examined how technology-driven audits influence procurement governance outcomes, such as audit integration, transparency, oversight effectiveness, and risk management, in practice. This gap is especially relevant in environments where conventional audit methods remain dominant, despite the ongoing digitalisation of procurement.

This study was guided by a conceptual framework that linked technology-driven audits to procurement governance outcomes in public-sector supply chains. Technology-driven audits were conceptualised as audit processes supported by digital platforms, automated controls, and advanced analytics that enhance audit traceability, information integration, and risk management across the procurement value chain. By embedding digital audit tools within procurement systems, public institutions are better positioned to strengthen governance mechanisms and address systemic inefficiencies that conventional audit approaches have struggled to resolve.

Against this background, this study aimed to examine how technology-driven audits can enhance good governance in Namibia's public procurement system. Specifically, the study sought to: (i) assess the current state of technology adoption in procurement auditing; (ii) analyse challenges associated with conventional procurement audit methods; and (iii) determine how technology-driven audits strengthen procurement governance outcomes. The study offers evidence-based findings relevant to public entities, regulators, and oversight bodies, contributing to policy reform, improved resource utilisation, and stronger procurement governance within Namibia and comparable developing-country contexts.

## LITERATURE REVIEW

### Public Procurement Governance and Auditing

In today's rapidly evolving digital landscape, integrating technology across government agencies is vital to effective governance. Technology adoption facilitates the transformation of service delivery mechanisms. By leveraging digital platforms, governments can overcome conventional bureaucratic hurdles, providing citizens and businesses with seamless access to essential services. This evolution involves the development of user-friendly online portals, mobile applications, and automated systems that enhance the efficiency of public Procurement in the Namibian Context. The Public Procurement Act, 2015 (Act No. 15 of 2015), governs the procurement system of the Republic of Namibia and repeals the Tender Board Act, 1996 (Act No. 16 of 1996). The former Act, rooted in apartheid regulatory structures, had become ineffective in promoting transparency, accountability, and limited equitable participation. The 2015 legislative session seeks to promote sound governance principles in response to the former inequities. Drawing inspiration from the United Nations Commission on International Trade Law's (UNCITRAL) Model Law on Procurement, the Act aligns Namibia's regulatory framework with international best practices while tailoring it to the country's socio-economic and institutional realities (Warikandwa & Usebui, 2023). The Public Procurement Act officially took effect on April 1st, 2017, and while it signified progress, challenges related to implementation, compliance, accountability, and transparency remain (Marenga, 2020).

### Digital Transformation and Technology Adoption in the Public Sector

Digital transformation has become a central pillar of public sector reform, as governments increasingly adopt information and communication technologies to enhance efficiency, transparency, and accountability. In developing-country contexts, digitalisation is frequently positioned as a governance intervention intended to modernise administrative processes, reduce discretion, and strengthen institutional integrity (Bora, 2023; Le, 2024). Through e-government platforms, integrated information systems, and automated processes, public institutions aim to enhance service delivery while addressing longstanding governance challenges.

In public procurement, digital transformation has focused mainly on introducing electronic procurement systems, online tender portals, and digital record management. These initiatives are designed to standardise procurement procedures, expand access to procurement information, and reduce opportunities for manipulation and corruption (Maepa et al., 2023). Evidence indicates that digital procurement systems can enhance procedural transparency, improve compliance with procurement regulations, and increase operational efficiency when effectively implemented and supported by appropriate institutional arrangements (Mandala et al., 2024).

However, technology adoption in the public sector has not consistently translated into improved governance outcomes. Research highlights that digital initiatives often face organisational, technical, and cultural constraints that limit their effectiveness. Common barriers include insufficient leadership commitment, weak information technology project management capacity, inadequate financial and human resources, limited user training, and resistance to change within hierarchical bureaucratic structures (Christopher & Tano, 2021; Molepo, 2023; Ocansey, 2021). Risk aversion and rigid administrative cultures further constrain innovation, resulting in partial adoption or parallel use of manual and digital systems (Oluoch, 2022).

Another critical challenge relates to the lack of integration across government information systems. Digital transformation efforts implemented in isolation, without coordination among procurement, finance, and audit functions, often exacerbate system fragmentation rather than resolve it (Watuwa & Eilu, 2024). In public procurement, this fragmentation undermines institutions' ability to generate consolidated data, conduct real-time monitoring, and support evidence-based oversight. Consequently, while procurement execution may be digitalised, audit and control functions frequently remain disconnected from procurement data flows, limiting the governance value of digital investments.

Research further suggests that successful technology adoption in the public sector depends on institutional readiness and change-management strategies rather than technological capability alone. Leadership support, stakeholder engagement, continuous capacity development, and alignment with broader organisational strategies

are essential for embedding digital systems into routine administrative practice (Mandala et al., 2024). Without these enabling conditions, digital initiatives risk becoming symbolic reforms that fail to transform underlying governance processes.

Overall, digital transformation in the public sector should be understood as an institutional and governance process rather than a purely technical exercise. While digital procurement systems can enhance procedural efficiency, their contribution to good governance depends on how effectively they are integrated into oversight, accountability, and audit mechanisms. This perspective highlights the importance of examining complementary governance tools, particularly auditing functions, that can utilise digital technologies to enhance transparency, accountability, and risk management in public procurement systems.

### **Conventional Procurement Audits and Their Limitations**

Conventional procurement audits refer to traditional public sector audit approaches used to assess whether procurement activities comply with applicable laws, regulations, policies, and prescribed procedures. Such audits typically involve periodic, post-transaction examinations of procurement files, contracts, financial records, and supporting documentation to verify legality, regularity, and procedural correctness (Bergman, 2023; INTOSAI, 2019). The primary objective of conventional procurement audits is to ensure that public funds are utilised in accordance with established governance requirements, thereby supporting accountability and fiscal control within public procurement systems (Pomeranz & Stedman, 2020; Lugli & Bertacchini, 2023).

Within public sector governance frameworks, conventional procurement audits serve as a core oversight mechanism, identifying non-compliance, procedural weaknesses, and instances of irregular expenditure. Audit practices of this nature are predominantly compliance-oriented, rule-based, and conducted after procurement activities have been completed. While this approach reinforces regulatory enforcement, it offers limited capacity for continuous monitoring, early risk identification, or performance-based evaluation across the procurement lifecycle (Motubatse & Ngwakwe, 2020; Kakwezi & Nyeko, 2019). As public procurement systems grow in scale and complexity, the limitations of purely ex post audit models become increasingly evident.

A significant limitation of conventional procurement audits is their reliance on manual, paper-based processes. Audit procedures often rely on physical documentation, manual sampling, and professional judgement, which can restrict the scope, depth, and timeliness of the audit (McGregor & Carpenter, 2020; Pavel et al., 2020). Retrospective review processes often identify procurement irregularities only after contracts have been awarded or payments have been processed, thereby reducing opportunities for preventive intervention and effective risk mitigation (Castka, 2020). Consequently, conventional procurement audits operate primarily as reactive rather than proactive governance instruments.

Further constraints arise from fragmented information environments within public procurement systems. Procurement data are commonly dispersed across multiple platforms or maintained in non-integrated formats, limiting auditors' access to complete, accurate, and timely information. Fragmentation of this nature weakens audit traceability, complicates evidence verification, and restricts the application of analytical techniques required to identify recurring risks, inefficiencies, or systemic governance failures (Felizzola et al., 2024; Omotayo et al., 2024). Audit outcomes under such conditions often capture isolated compliance issues rather than providing comprehensive assessments of procurement performance and risk exposure.

Resource intensity and limited analytical capability further constrain conventional procurement audits. Manual verification processes increase audit duration and workload while heightening the risk of errors and inconsistencies. These constraints reduce auditors' capacity to analyse large procurement datasets or detect complex risks such as collusion, supplier concentration, and contract manipulation (McGregor & Carpenter, 2020; Pavel et al., 2020). In procurement environments characterised by high transaction volumes and increasing digitalisation, such limitations significantly undermine audit effectiveness.

In the Namibian context, procurement audits continue to rely mainly on conventional methodologies despite the gradual digitalisation of procurement operations. Limited system integration and minimal use of data analytics contribute to delayed detection of procurement irregularities, weak real-time oversight, and reduced audit responsiveness (Castka, 2020; Lima & Gomez, 2025). These conditions reflect broader institutional challenges associated with transitioning from compliance-focused oversight towards data-driven governance mechanisms within public procurement systems (World Bank & African Development Bank, 2024).

Conventional procurement audits, therefore, remain essential for compliance assurance within public sector procurement systems; however, structural and operational limitations significantly constrain their capacity to support proactive governance, effective risk management, and continuous improvement. The reliance on manual processes, fragmented information systems, and retrospective review limits the ability of conventional audits to respond to the growing complexity and scale of public procurement activities. These limitations provide a strong

justification for adopting technology-driven audit approaches to enhance audit integration, analytical capability, and governance outcomes across public procurement systems.

### **Technology-Driven Audits in Public Procurement**

Technology-driven audits refer to audit approaches that integrate digital tools, automated processes, and data analytics into the planning, execution, and reporting of audits. In contrast to conventional audits, which rely primarily on manual document review and retrospective verification, technology-driven audits enable continuous access to procurement data, automated testing of controls, and the timely identification of risks and irregularities (Alles & Grey, 2020; Otia & Bracci, 2022). Such approaches reposition auditing from a narrowly compliance-oriented function towards a more analytical, preventive, and governance-enhancing role.

Within public procurement systems, technology-driven audits are operationalised through integrated information platforms, data analytics applications, and computer-assisted audit techniques (CAATs). These tools enable auditors to analyse large volumes of procurement transactions, examine supplier behaviour, assess contract performance, and identify anomalies related to pricing, compliance, and risk exposure (Pavel et al., 2020; Omotayo et al., 2024). Automation improves audit consistency, reduces reliance on manual sampling, and enhances the accuracy and timeliness of audit outputs (Lugli & Bertacchini, 2023).

Evidence from international public sector contexts suggests that technology-driven audits contribute to more effective procurement governance outcomes. Digital audit systems enhance transparency by strengthening traceability across procurement processes and reinforcing accountability through verifiable audit trails (Bora, 2023; Felizzola et al., 2024). Data-driven audit techniques further support value-for-money assessments by enabling performance-oriented analysis, rather than relying solely on procedural verification. Continuous auditing models aligned with INTOSAI principles also support early risk detection and corrective intervention, thereby improving oversight effectiveness (INTOSAI, 2019).

Implementation of technology-driven audits within the public sector, however, remains uneven across developing economies. Empirical studies identify several constraints affecting adoption, including limited ICT infrastructure, insufficient digital skills among audit personnel, budgetary pressures, weak interoperability between systems, and resistance to organisational change (Christopher & Tano, 2021; Molepo, 2023; Oluoch, 2022). In the absence of institutional readiness and sustained capacity development, digital audit initiatives frequently coexist with conventional audit practices, which reduces their potential governance impact.

In Namibia, public procurement reforms have prioritised the digitalisation of procurement processes, while audit functions have evolved more slowly. Limited integration between procurement platforms, financial management systems, and audit processes constrains auditors' ability to utilise available data effectively for governance and risk management purposes (World Bank & African Development Bank, 2024). As a result, opportunities to strengthen real-time oversight, enhance audit responsiveness, and improve transparency remain underexploited.

Technology-driven audits, therefore, represent a critical governance mechanism for strengthening public procurement systems. Embedding digital tools within audit functions and aligning audit practices with integrated procurement and financial systems can enhance audit effectiveness, improve risk responsiveness, and promote good governance in procurement. Examination of these relationships provides the basis for the conceptual framework developed in this study.

### **Conceptual Framework for Technology-driven Procurement Audit**

Developing a conceptual framework is crucial to understanding how technology-driven audits affect procurement governance in Namibia's public sector. The framework provides the analytical structure for examining the interaction among technological readiness, the limitations of conventional audit practices, and governance outcomes. It translates abstract theoretical arguments into a structured model that supports empirical testing and offers practical guidance for strengthening public procurement oversight.

The conceptual framework is grounded in governance theory and the Technology Acceptance Model (TAM), which together explain both institutional and behavioural dimensions of audit transformation. Governance theory provides an institutional lens for understanding how rules, oversight mechanisms, and accountability structures shape procurement outcomes. In contrast, TAM explains how perceptions of usefulness, ease of use, and organisational support influence the adoption of digital audit tools within public institutions (Warsono et al., 2023; Kjaer, 2023). Integrating these perspectives allows the framework to capture how governance capacity and technology adoption jointly affect procurement good governance.

As illustrated in Figure 1, the framework is structured around four interrelated constructs: Current State of Technology (CST), Challenges in Conventional Procurement Audit Methods (CPA), Implementation of

Technology-Driven Audits (ITA), and Procurement Good Governance (PPG). These constructs represent the technological, organisational, and governance dimensions that interact to facilitate the transition from manual audit practices to digitally enabled audit systems in Namibia's public procurement environment.

### **Current State of Technology (CST)**

The Current State of Technology refers to the level of technological and organisational preparedness of public entities to support technology-driven auditing. This construct encompasses the availability and integration of digital infrastructure, procurement and financial management systems, data management capabilities, ICT skills, management commitment, and institutional support mechanisms. CST reflects whether public entities possess the foundational capacity required to adopt, operate, and sustain digital audit tools effectively.

Literature indicates that ICT readiness and system interoperability are critical determinants of successful digital transformation in the public sector (Maepa et al., 2023; Ndubuisi et al., 2021). Weak infrastructure, fragmented data systems, and limited management support reduce the effectiveness of digital initiatives and constrain audit innovation. Within the framework, CST functions as an enabling condition that shapes the feasibility and quality of technology-driven audit implementation.

### **Conventional Procurement Audit methods (CPA)**

The Challenges in Conventional Procurement Audit Methods construct captures the operational and systemic limitations associated with traditional, paper-based audit practices. These challenges include reliance on manual documentation, fragmented record-keeping, restricted access to procurement data, delayed detection of irregularities, compromised data integrity, and increased vulnerability to errors and manipulation.

Empirical evidence suggests that conventional audits in public procurement are often reactive and compliance-oriented, focusing on post-transaction verification rather than proactive risk management and performance assessment (Lugli & Bertacchini, 2023; Motubatse & Ngwakwe, 2020), such approaches limit auditors' ability to provide timely assurance and weaken procurement oversight. Within the conceptual framework, CPA represents the structural deficiencies that motivate the transition toward technology-driven audits.

### **Implementing Technology-Driven Audits (ITA)**

Implementation of Technology-Driven Audits represents the central transformation mechanism within the framework. ITA refers to the extent to which public entities adopt and operationalise digital tools such as automated audit systems, data analytics, Computer-Assisted Audit Techniques (CAATs), and integrated financial and procurement platforms. This construct reflects both strategic intent and operational execution in modernising audit practices.

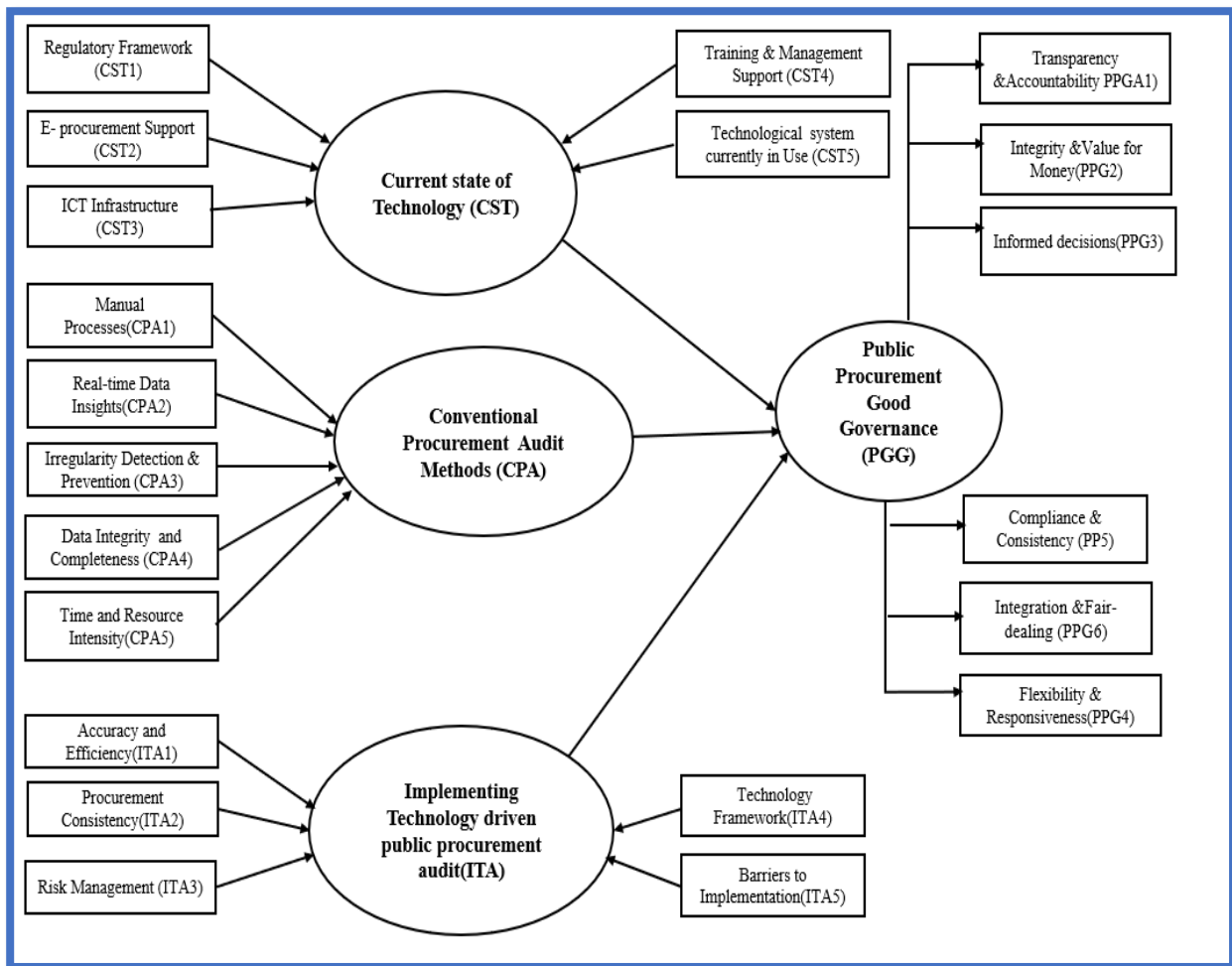
Technology-driven audits enhance audit efficiency, improve traceability, facilitate continuous monitoring, and enable auditors to focus on analytical and risk-based activities (Naqvi, 2020; Bora, 2023). Effective implementation depends on the interaction between technological capacity (CST) and the urgency created by limitations in conventional audit methods (CPA). Within this framework, ITA serves as the linking construct through which technological readiness and audit challenges are translated into improved governance outcomes.

### **Procurement Good Governance (PPG)**

Procurement Good Governance represents the outcome construct of the framework. It reflects the extent to which procurement practices comply with the principles set out in Section 2(a) of Namibia's Public Procurement Act, namely integrity, accountability, transparency, competitive supply, effectiveness, efficiency, fair dealing, responsiveness, informed decision-making, consistency, legality, and integration (Government Gazette, 2017).

Technology-driven audits support these principles by strengthening oversight, improving data accuracy, enhancing transparency, and facilitating the timely detection of irregularities (Alles & Grey, 2020; World Bank & African Development Bank, 2024). Within the framework, PPG captures the governance improvements achieved through successful audit transformation.

Together, these constructs form an integrated technology-governance pathway that demonstrates how technological capacity and digital audit practices enhance good governance in procurement.



**Figure 1:** Technology-driven Procurement Audit Framework

Figure 1 illustrates the conceptual framework underpinning the study. The framework is structured around four interrelated constructs: Current State of Technology (CST), Challenges in Conventional Procurement Audit Methods (CPA), Implementation of Technology-Driven Audits (ITA), and Procurement Good Governance (PPG). These constructs represent the technological, organisational, and governance dimensions that interact to facilitate the transition from manual audit practices to digitally driven audit systems in Namibia's public procurement environment.

### Technology Adoption and Technology-driven Audits in Public Procurement

Digital transformation has become a central reform trajectory in public sector governance, particularly in developing economies where technology is increasingly recognised as a mechanism for strengthening accountability, transparency, and institutional performance (Bora, 2023; Le, 2024). Governments have expanded e-government initiatives and digital management systems to modernise administrative processes, enhance institutional integrity, and improve citizen trust (Maepa et al., 2023). These reforms reflect a broader shift towards data-driven governance and evidence-based decision-making within public institutions.

However, technology adoption in the public sector has not consistently produced the anticipated governance outcomes. Organisational, technical, and cultural constraints continue to limit the effectiveness of digital initiatives. Empirical studies identify persistent barriers, including limited leadership commitment, weak information systems governance, resource constraints, inadequate training, low levels of user engagement, and resistance to organisational change (Christopher & Tano, 2021; Molepo, 2023; Ocansey, 2021). Hierarchical administrative structures and risk-averse institutional cultures further constrain innovation and slow the institutionalisation of digital systems across government operations (Oluoch, 2022).

Effective public sector digitalisation, therefore, requires more than the deployment of technological infrastructure. Governance-oriented change-management strategies, leadership commitment, strategic alignment, and sustained capacity development are critical for embedding digital systems into routine administrative and oversight functions (Mandala et al., 2024). Digital transformation yields meaningful outcomes when governance

structures, organisational processes, and institutional values evolve in tandem with technological change, rather than operating independently (Watuwa & Eilu, 2024).

Within this broader digital governance context, auditing has emerged as a priority domain for technology adoption, given its central role in public accountability, oversight, and risk management. Manual procedures, paper-based documentation, fragmented records, and retrospective compliance checks are typically characteristic of conventional public-sector procurement audits. Such practices constrain audit timeliness, reduce analytical depth, and weaken the capacity to detect procurement irregularities proactively (Lugli & Bertacchini, 2023; Motubatse & Ngwakwe, 2020). In Namibia, procurement audits remain largely compliance-oriented and disconnected from real-time procurement and financial data, resulting in weak audit traceability and delayed identification of irregularities (Castka, 2020; Lima & Gomez, 2025).

Technology-driven audits represent a strategic response to these limitations. By integrating digital platforms, automated audit procedures, and data analytics, technology-driven audits enhance audit efficiency, improve traceability, and support continuous monitoring across the procurement lifecycle (Naqvi, 2020; Bora, 2023). Internationally, audit institutions are transitioning towards digital audit models aligned with INTOSAI principles, which emphasise transparency, evidence-based assurance, and timely oversight (INTOSAI, 2019).

Integrated Financial Management Systems (IFMS) and Computer-Assisted Audit Techniques (CAATs) constitute core enablers of technology-driven procurement audits. IFMS enhances fiscal transparency by integrating budgeting, accounting, and expenditure controls, while CAATs facilitate automated testing, real-time data analysis, and improved audit quality (Sayana & CISA, 2023; Owino & Musuva, 2021). In practice, limited interoperability between procurement systems, financial management platforms, and audit tools constrains the governance impact of these technologies within the public sector.

The literature indicates that realising the governance potential of technology-driven audits requires integrated digital frameworks supported by institutional readiness, leadership commitment, and sustained capacity development. Aligning procurement operations, financial management systems, and audit oversight within coherent governance structures is essential for strengthening transparency, accountability, and resilience in public procurement systems.

## Public Procurement Good Governance

Public procurement good governance refers to the institutional frameworks, systems, and control mechanisms that ensure procurement processes are conducted ethically, transparently, and in a manner that safeguards public resources while delivering value to society (Pomeranz & Stedman, 2020; Dorasamy & Fagbadebo, 2021; Manpaya et al., 2023). Within the public sector, procurement governance serves as both an administrative control system and an indicator of state performance, reflecting the extent to which public institutions uphold accountability, integrity, and efficiency in the allocation of public funds.

In Namibia, procurement governance is legally anchored in the Public Procurement Act of 2015 (Act No. 15 of 2015), which institutionalises good governance principles across all public procurement activities. Section 2(a) of the Act defines the core objects of public procurement and establishes a comprehensive governance framework grounded in the principles of integrity, accountability, transparency, competitive supply, effectiveness, efficiency, fair dealing, responsiveness, informed decision-making, consistency, legality, and integration (Government Gazette, 2017). Collectively, these principles provide the normative and operational foundation for managing procurement processes in a manner that is fair, lawful, and results-oriented, while aligning national procurement practices with international standards (Alles & Gray, 2020).

Integrity underpins procurement governance by requiring ethical conduct, professionalism, and the avoidance of conflicts of interest throughout the procurement cycle, thereby reducing opportunities for corruption and reinforcing public trust (Herasymiuk et al., 2020; OECD, 2021). Transparency promotes openness by ensuring that procurement information, procedures, and decisions are accessible and traceable, enabling public scrutiny and strengthening oversight mechanisms (Muriuki, 2021; Mandala et al., 2024). Accountability obliges procurement officials and institutions to justify decisions and actions, reinforcing compliance, internal controls, and auditability (Kakwezi & Nyeko, 2019; INTOSAI, 2022; Mokhtar et al., 2024).

The principle of competitive supply ensures equal treatment of bidders and fosters fair competition, which enhances innovation, market efficiency, and value for money (Darr, 2020; Alhabatah et al., 2023). Effectiveness and efficiency focus on achieving procurement objectives in a timely and cost-effective manner, ensuring that public resources are optimally utilised to meet service delivery needs (Palar et al., 2021; Bergman, 2023; Bosio et al., 2023). Fair dealing reinforces procedural fairness and impartiality in interactions with suppliers, while responsiveness emphasises procurement systems' ability to adapt to stakeholder needs, market conditions, and emerging risks (Christopher & Tano, 2021; Heeks, 2021; Watuwa & Eilu, 2024).

Informed decision-making requires the use of accurate, timely, and reliable information to support procurement planning, evaluation, and contract management, reducing discretionary decision-making and improving outcomes (Lam & Yang, 2020). Consistency ensures the uniform application of procurement rules and procedures across public entities, promoting predictability, fairness, and legal certainty (Abul Hassan et al., 2021). Legality upholds adherence to statutory and constitutional provisions, reinforcing the rule of law and protecting public funds from misuse (Public Procurement Act, 2015; Mlambo et al., 2020). Integration strengthens coordination between procurement, financial management, and audit systems, enabling cohesive oversight and enhancing governance effectiveness across the public sector (Manpaya et al., 2023; World Bank & African Development Bank, 2024).

Beyond procedural compliance, these principles reflect the broader relationship between procurement governance and accountability. When effectively applied, they contribute to institutional stability, improved public service delivery, macroeconomic discipline, and social cohesion by ensuring that public resources are allocated transparently and in the public interest (Lam & Yang, 2020; Denters et al., 2023; Mavidis et al., 2024). Within this context, procurement governance extends beyond regulatory compliance to serve as a strategic mechanism for advancing national development objectives.

Namibia's procurement governance framework is supported by clearly defined institutional structures established under the Act. Externally, the Procurement Policy Unit (PPU) provides policy oversight, monitors compliance, and promotes adherence to procurement principles, functioning as the central coordinating authority. The Central Procurement Board of Namibia (CPBN) conducts high-value and complex procurements, ensuring value for money while maintaining high standards of integrity and transparency. The Review Panel (RP) safeguards procedural fairness by resolving procurement disputes and complaints, reinforcing confidence in the system (Government Gazette, 2017). Internally, each public entity is supported by governance structures comprising the Accounting Officer, Procurement Committee, Procurement Management Unit, and Bid Evaluation Committee, which collectively oversee planning, execution, evaluation, and control of procurement activities.

Together, these principles and institutional arrangements form an integrated governance system for procurement. Strengthening this system through technology-driven audits offers a critical pathway to enhance transparency, accountability, and effectiveness in Namibia's public procurement system.

## LITERATURE GAP

The role of digital technologies in public procurement governance has been widely examined, particularly in relation to e-procurement systems, financial management platforms, and digital auditing. However, empirical gaps remain. Limited research has examined technology-driven procurement audits as a distinct governance mechanism within public sector procurement systems in developing countries. Existing studies often treat procurement operations, audit practices, and technology adoption in isolation, providing limited insight into how digital audit transformation directly strengthens procurement governance. In the Namibian context, empirical evidence examining the interaction between conventional audit challenges, technological readiness, and governance outcomes remains scarce. Addressing these gaps is necessary to strengthen procurement oversight and advance context-specific knowledge on technology-driven procurement governance.

## METHODOLOGY

### Study Design

This study adopted a descriptive, cross-sectional quantitative research design to examine the relationships between technology-driven procurement audits and public procurement good governance in Namibia's public sector. The design enabled the measurement and statistical analysis of key constructs using survey data collected from procurement and audit professionals.

### Setting

The study was conducted within Namibia's public sector procurement environment, encompassing government ministries, agencies, regional councils, local authorities, and state-owned enterprises operating under the Public Procurement Act, 2015. These entities operate within a regulated procurement system overseen by both central and decentralised governance structures, making them suitable for examining audit practices and governance outcomes.

## Study Population and Sampling Strategy

The study population comprised procurement practitioners, internal auditors, external auditors, and senior officials involved in public procurement and audit oversight across Namibia’s public sector. These participants were drawn from government ministries, agencies, regional councils, local authorities, state-owned enterprises, and key oversight institutions established under the Public Procurement Act of 2015 (Government Gazette, 2017).

A stratified random sampling strategy was employed for the quantitative component to ensure proportional representation across institutional categories and to minimise sampling bias. Stratification was appropriate given the heterogeneous nature of procurement roles and varying levels of exposure to technology-driven audit systems within the public sector. The overall sample size of 332 respondents was determined using a finite-population correction based on a known population of 446 professionals. This sample size exceeds recommended thresholds for regression and multivariate analysis, ensuring adequate statistical power and model stability (Hair et al., 2019; Ghosh, 2021). Proportional allocation was applied across strata to preserve the population structure and enhance representativeness.

Quantitative data were collected through an online survey, yielding 327 valid responses, which were retained for analysis after data screening and validation. Inclusion criteria required participants to be employed within a public entity or oversight institution and to have direct responsibility for procurement or audit functions. Responses with substantial missing data were excluded from the final dataset.

## Data Collection

Quantitative data were collected using a structured online questionnaire comprising items measured on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The instrument measured four constructs: Current State of Technology (CST), Challenges in Conventional Procurement Audit Methods (CPA), Implementation of Technology-Driven Audits (ITA), and Procurement Good Governance (PPG). Measurement items were adapted from established literature to enhance content validity (Bora, 2023; Lugli & Bertacchini, 2023; Mandala et al., 2024). Prior to conducting the primary survey, the questionnaire was pilot tested with 10 procurement and audit professionals to assess the clarity, relevance, and reliability of the measurement items.

## Data Analysis

Quantitative data were analysed using SPSS. Data screening included checks for missing values, outliers, and internal consistency. Descriptive statistics summarised key variables, while inferential analysis involved correlation and regression techniques to examine relationships among CST, CPA, ITA, and PPG (Hair et al., 2019; Denis, 2020).

## Ethical Consideration

Ethical clearance for the study was obtained from the University of KwaZulu-Natal Humanities and Social Research Ethics Committee (University of KwaZulu-Natal Humanities and Social Research Ethics Committee) on 14 December 2023.

## Reliability and Sampling Adequacy

The internal consistency and suitability of the data for multivariate analysis were assessed before substantive analysis. All constructs demonstrated strong reliability, with Cronbach’s alpha coefficients ranging between 0.825 and 0.916, exceeding the recommended threshold of 0.70. Sampling adequacy was confirmed through the Kaiser–Meyer–Olkin (KMO) measure (KMO = 0.894), while Bartlett’s Test of Sphericity was statistically significant ( $\chi^2 = 1782.854$ ;  $df = 325$ ;  $p < 0.001$ ), indicating that the correlation matrix was appropriate for factor and regression analysis.

**Table 1: KMO and Bartlett’s Test**

KMO and Bartlett's tests		
Kaiser-Meyer-Olkin		0.894
Bartlett's Test of Sphericity	Approx. Chi-Square	1782.854
	df	325
	Sig.	.000

These results, illustrated in Table 1, confirm that the dataset was robust and suitable for subsequent descriptive and inferential analysis.

### Descriptive Statistics of Study Constructs

The descriptive analysis across the four study constructs reveals uneven patterns in technological readiness, audit practice, and procurement governance within Namibia's public sector. The Current State of Technology (CST) recorded moderate mean scores ( $M = 3.10\text{--}4.14$ ), indicating partial availability of digital systems supporting procurement oversight, alongside notable disparities in ICT infrastructure and system integration across public entities. Conventional Procurement Audit Methods (CPA) consistently displayed high mean values ( $M = 3.92\text{--}4.06$ ), confirming the continued dominance of manual, compliance-driven audit practices. In contrast, the Implementation of Technology-Driven Audits (ITA) showed lower, more variable mean scores ( $M = 2.95\text{--}3.64$ ), suggesting uneven adoption of digital audit tools despite acknowledged institutional awareness of their potential benefits. Procurement Good Governance (PGG) outcomes were moderate and varied ( $M = 3.16\text{--}4.08$ ), with relatively stronger scores for transparency and accountability and lower scores associated with responsiveness, ethical governance, and system integration. Collectively, these results reveal observable gaps between technological capacity, audit practices, and governance outcomes, underscoring the structural constraints that affect the effective implementation of technology-driven procurement audits in Namibia.

**Table 2: Descriptive Statistics**

Current State of Technology (CST)				Conventional Procurement Audits (CPA)				Implementation of Technology-Driven Audits (ITA)			
	Mean	Standard Deviation	Missing Values		Mean	Standard Deviation	Missing Values		Mean	Standard Deviation	Missing Values
<b>CST2</b>	4.14	1.175	0	<b>CPA1</b>	4.06	1.085	0	<b>ITA1</b>	3.64	1.205	0
<b>CST4</b>	3.85	1.132	0	<b>CPA4</b>	4.05	1.099	0	<b>ITA3</b>	3.46	1.188	0
<b>CST1</b>	3.77	1.287	0	<b>CPA5</b>	3.97	1.109	0	<b>ITA5</b>	3.42	1.07	0
<b>CST5</b>	3.7	1.188	0	<b>CPA3</b>	3.93	1.037	0	<b>ITA4</b>	3.28	1.176	0
<b>CST3</b>	3.1	1.382	0	<b>CPA2</b>	3.92	1.055	0	<b>ITA2</b>	2.95	1.374	0
Procurement Good Governance (PGG)											
	Mean	Standard Deviation	Missing Values								
<b>PGG3</b>	4.08	1.036	0								
<b>PGG5</b>	3.88	1.089	0								
<b>PGG4</b>	3.84	1.195	0								
<b>PGG1</b>	3.52	1.277	0								
<b>PGG2</b>	3.34	1.042	0								
<b>PGG6</b>	3.16	1.231	0								

Table 2 illustrates the uneven performance across technological readiness, conventional audit practices, the implementation of technology-driven audits, and procurement good governance, demonstrating apparent gaps between system capacity, audit execution, and governance outcomes. These results confirm the presence of constraints in conventional audit methods, highlight limited implementation of digital audits, and underscore the need for integrated, technology-driven audit reforms to enhance accountability, transparency, and overall procurement good governance in Namibia.

### Barriers to Implementing Technology-Driven Procurement Audits

The results indicate that the implementation of technology-driven procurement audits in Namibia is primarily constrained by structural and institutional barriers, rather than a lack of conceptual acceptance. As reflected in Table 6, the most significant barriers reported by respondents are the high cost of technology (36%), followed by skills and competency gaps (24%), and resistance to organisational change (21%). Limited ICT infrastructure (13%) remains a material constraint, particularly among smaller public entities. These findings suggest that while awareness of digital audit benefits exists, implementation capacity is uneven and shaped by financial limitations, human capital deficits, and institutional readiness.

**Table 3. Barriers to Implementing Technology-driven Audits**

CST5	Frequency	Percentage	Cumulative frequency
Lack of skills and competencies	79	24	23.9
High cost of technology	117	36	59.6
Resistance to change	69	21	80.7
Limited infrastructure	43	13	99.7
None	19	6	86.5
Total	327	100.0	100.0

The distribution of responses demonstrates that barriers to technology-driven audits are multidimensional, combining fiscal, technical, and organisational challenges.

### Impact of Conventional Procurement Audit Methods on Public Procurement Good Governance

The results indicate that conventional procurement audit practices are significantly associated with weaker public procurement governance outcomes in Namibia. As shown in Table 5, manual audit methods remain the dominant approach, accounting for 47.4% of procurement audit practices, while 37.6% of public entities report having no technological audit tools. This reliance on manual, compliance-driven audits constrains audit traceability and delays the detection of procurement irregularities, thereby weakening transparency, accountability, and responsiveness.

Quantitative evidence further shows that limited technological capacity restricts effective audit oversight, reflected in the relatively low mean score for ICT infrastructure readiness ( $M = 3.10$ ). The correlation analysis presented in Table 4 confirms a strong and statistically significant association between Conventional Procurement Audit methods (CPA) and Procurement Good Governance (PGG) ( $r = 0.698$ ,  $p < 0.001$ ), indicating that audit practices have a material influence on governance performance. Collectively, the findings indicate that continued reliance on conventional audit approaches constitutes a structural constraint on effective procurement governance.

**Table 4: Pearson Correlation Analysis**

CONSTRUCTS		CST	CPA	ITA	PGG
Current State of Technology (CST)	Pearson Correlation	1	0.578**	0.687**	0.533**
	Sig. (2-tailed)		.000	.000	0.0000
	N	327	327	101	327
Conventional Procurement Audit (CPA)	Pearson Correlation	0.578**	1	0.674**	0.698**
	Sig. (2-tailed)	.000		.000	.000
	N	327	327	327	327
Implementing Technology-Driven Audit (ITA)	Pearson Correlation	0.687**	0.674**	1	0.654**
	Sig. (2-tailed)	.000	.000		.000
	N	327	327		327
Resilient Public Procurement Good Governance (RPG)	Pearson Correlation	0.659**	0.776**	0.719**	0.727**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	327	327	327	327
Procurement Good Governance (PGG)	Pearson Correlation	0.533**	0.698**	0.654**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	327	327		327

Collectively, Table 4 shows positive and statistically significant correlations among all study constructs ( $p < 0.001$ ). CPA are strongly associated with PGG ( $r = 0.698$ ), while the CST also shows a significant relationship with PGG ( $r = 0.533$ ). These results confirm meaningful associations between audit practices, technological readiness, and governance outcomes.

### Current State of Technology in Public Procurement Auditing

An essential foundation for evaluating Namibia's preparedness lies in its legal and institutional framework, which delineates the distinctive aspects of governance organisations tasked with ensuring regulatory compliance throughout the procurement process. The study findings indicate that the execution of digital auditing initiatives remains fragmented and underdeveloped across public entities. As shown in Table 5, most public entities continue to rely on non-digital audit approaches. Manual audit methods account for 47.4% of procurement audit practices, while 37.6% of entities reported that no technological tools are used at all in procurement auditing. In contrast,

the use of core digital audit technologies remains minimal, with only 5.2% of respondents reporting the use of e-procurement systems, 5.1% of respondents reporting the use of Computer-Assisted Audit Techniques (CAATs), and 4.3% utilising data analytics tools. Artificial intelligence applications were almost absent, reported by only 0.3% of respondents.

**Table 5. Technologies Currently Used in Procurement Audits**

Technology Type (CST)	Percentage
E-procurement systems	5.2
Data Analytics tools	4.3
Artificial Intelligence (AI)	0.3
CAATs	5.1
Manual methods	47.4
None	37.6
Total	100.0

These results demonstrate a fragmented digital audit environment, where existing systems are either underutilised or operate in isolation. The limited adoption of integrated technologies constrains real-time monitoring, automated audit trails, and data-driven risk analysis, all of which are central to effective technology-driven procurement audits. The findings therefore confirm that current technology does not yet provide an adequate foundation for advanced procurement audit practices in Namibia's public sector.

## DISCUSSION OF RESULTS

The study aimed to examine how technology-driven audits enhance public procurement governance in Namibia. The findings confirm that digitalisation of audit functions is a governance reform instrument that operationalises the procurement principles enshrined in Section 2(a) of the Public Procurement Act (2015).

Firstly, the results demonstrate that current technology has a significant influence on governance outcomes. The statistically significant correlation between the Current State of Technology and Procurement Good Governance ( $r = 0.533$ ,  $p < 0.001$ ) indicates that ICT readiness, system integration, and institutional support strengthen transparency, accountability, and informed decision-making. These results align with evidence that fragmented digital environments constrain audit effectiveness and limit real-time oversight in public procurement systems (Mandala et al., 2024; Lugli & Bertacchini, 2023).

Secondly, the findings reveal that reliance on conventional procurement audit methods undermines governance performance. The strong association between Conventional Procurement Audit Methods and Procurement Good Governance ( $r = 0.698$ ,  $p < 0.001$ ) confirms that manual, compliance-driven audits weaken transparency, accountability, and responsiveness. High levels of manual auditing were associated with delayed detection of irregularities, limited audit traceability, and reduced assurance of value for money. These outcomes reinforce concerns that paper-based audits expose procurement systems to governance risks by constraining visibility, consistency, and evidence-based oversight (Herasymiuk et al., 2020; World Bank & African Development Bank, 2024).

Thirdly, the study demonstrates that implementing technology-driven audits improves procurement governance in both statistical and operational terms. Regression analysis indicates a strong positive effect of technology-driven audits on governance outcomes ( $\beta = 0.671$ ,  $p < 0.001$ ), confirming that digital audit mechanisms strengthen integrity, legality, and accountability through auditable transaction trails, time-stamped records, digital authentication, and role-based access controls (Kakwezi & Nyeko, 2019). Enhanced data visibility and standardised documentation improve transparency and consistency, reducing discretion and information asymmetry across public entities. Technology-driven audits also promote competitive supply and fair dealing by widening access to procurement information and constraining manual handling through standardised electronic workflows, thereby supporting equitable market participation (Althabatah et al., 2023; Mandala et al., 2024).

Furthermore, integrating analytics, CAATs, and financial systems, such as IFMS, improves effectiveness and efficiency by shortening audit cycles, reducing manual workloads, and strengthening audit feedback loops. These capabilities support informed decision-making by generating structured procurement intelligence, while earlier detection of anomalies enhances responsiveness and corrective action (Palar et al., 2021). Table 7 provides Principle-level evidence that supports these interpretations, showing that technology-driven audits significantly strengthen informed decision-making (84%,  $p < 0.01$ ) and compliance and consistency (80%,  $p < 0.01$ ). In comparison, conventional audits constrain transparency and accountability (78%,  $p < 0.01$ ) and integrity and value for money (75%,  $p < 0.05$ ).

**Table 7: Impact of Technology-Driven Audits on Principles of Good Governance in Namibia**

Procurement Good Governance Principle	Statistical (%)	Key Findings
Transparency and Accountability (PPG1)	78% $p < 0.01$	Conventional procurement audits hinder visibility and traceability of procurement data.
Integrity and Value for Money (PPG2)	75% $p < 0.05$	Conventional systems increase the risk of fraud and reduce cost-effectiveness.
Informed Decision-Making (PPG3)	84% $p < 0.01$	Technology enables strategic, data-informed decisions
Flexibility and Responsiveness (PPG4)	72% $p < 0.05$	Delays in manual audits hinder agility in procurement processes
Compliance and Consistency (PPG5)	80% $p < 0.01$	Automation improves adherence to procurement laws and consistency

Overall, the discussion demonstrates that technology-driven audits effectively translate statutory procurement principles into enforceable governance outcomes by strengthening internal controls, enhancing decision-making intelligence, and supporting consistent legal compliance. These findings provide a sound empirical basis for advancing digital audit reforms within Namibia's public procurement system and for future research on technology-driven governance in developing public sectors.

### Practical Implications

The findings suggest that managers should move beyond manual, compliance-oriented audit practices toward integrated, technology-driven systems that enable proactive risk detection and data-informed decision-making. Meanwhile, policymakers must address fragmentation by establishing coherent digital standards and interoperable audit frameworks across public entities. Persistent reliance on legacy systems continues to constrain real-time oversight, increase operational inefficiencies, and weaken traceability across the procurement lifecycle, thereby undermining the consistent application of good governance principles such as transparency, accountability, and value for money. From a governance perspective, adopting technology-driven audits strengthens internal controls and enhances institutional resilience by embedding auditability, consistency, and legality into procurement processes. Theoretically, these implications support the view that the effectiveness of digital audit reforms depends not only on technological availability but also on organisational readiness and adaptive capacity within public institutions.

### Strengths and Limitations

This study is strengthened by its large, diverse sample of public procurement and audit professionals, as well as by rigorous statistical analysis to examine governance relationships. The findings reflect respondents' professional perspectives and may not capture all operational variations across public entities. Future research could complement these insights with system-generated procurement and audit data.

### CONCLUSION

In summary, the study shows that public procurement governance in Namibia remains constrained by fragmented digital systems and continued reliance on conventional, manual audit practices, which limit transparency, accountability, and timely oversight. The findings confirm that technology-driven audits significantly strengthen procurement governance by improving audit traceability, supporting data-informed decision-making, and enhancing compliance with established governance principles. To realise these benefits, public entities should prioritise integrating procurement, financial, and audit systems, alongside sustained investment in ICT infrastructure and targeted capacity development for procurement and audit professionals. Strengthening regulatory guidance to embed digital audit practices formally would further support consistent adoption across institutions. Advancing technology-driven audits is therefore essential for enhancing resilient, transparent, and accountable public procurement governance in Namibia.

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### Competing interest

The authors declare no conflict of interest related to the content discussed in this article.

### Data Availability

The data supporting this study are not publicly available due to confidentiality agreements with participating institutions and assurances of respondent anonymity.

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The opinions expressed in this article are the authors' own and may not necessarily align with any affiliated agency's official policies or positions.

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