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BLOCKCHAIN TECHNOLOGY AND PERFORMANCE OF SMART CONTRACTS IN PROCUREMENT OPERATIONS: A CASE STUDY OF EXPORT PROCESSING ZONES AUTHORITY IN KENYA

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ABSTRACT

Blockchain technology has emerged as a transformative innovation with diverse global applications beyond decentralized monetary transactions, extending into finance, governance, healthcare, and supply chain management. Despite its potential, the adoption of blockchain-based smart contracts continues to face challenges, including regulatory uncertainty, security vulnerabilities, and integration difficulties within established business models. This study examined the effect of blockchain technology on the performance of smart contracts in procurement operations at the Export Processing Zones Authority (EPZA) in Kenya, focusing on corporate transparency and decentralization. Grounded in the Technology Acceptance Model (TAM), Transaction Cost Theory (TCT), the Resource-Based View (RBV), and the Diffusion of Innovation (DOI) Theory, the research utilized structured digital questionnaires administered via Google Forms to a target population of 210 officers, including procurement, IT, finance, and compliance staff across EPZA's Athi River, Mombasa, and Kisumu branches. Multiple regression analysis using SPSS v28 was conducted to determine the relationship between blockchain technology and smart contract performance. The findings revealed that decentralization positively influences procurement performance by reducing dependence on intermediaries and minimizing manipulation in contract approvals. The results further support the view that blockchain-driven smart contracts enhance procurement efficiency, lower operational costs, and improve process integrity. However, the study also identified persistent challenges such as limited technical expertise, inadequate digital infrastructure, and weak legal frameworks that hinder full-scale adoption across African contexts. It concludes that blockchain technology possesses significant transformative potential for procurement operations through enhanced automation, security, and transparency and recommends that policymakers, practitioners, and scholars collaborate to strengthen regulatory frameworks, build institutional capacity, and invest in digital infrastructure to unlock the full benefits of blockchain-based smart contracts in procurement and other sectors.

Keywords: *Blockchain Technology, Organization Performance, Procurement Operations, Export Processing Zones Authority, Corporate Transparency, Decentralization*

INTRODUCTION

Blockchain technology and smart contracts have gained global prominence as tools to enhance integrity, automation, and transparency in complex multi-party transactions such as procurement (Govindan, 2024). Recent literature highlights the rapid maturity of Distributed Ledger Technologies (DLT), emphasizing that smart contracts can reduce transaction costs, eliminate intermediaries, and automate conditional payments to address persistent procurement challenges like fraud, delays, and weak audit trails (Bassan, 2024; Hariyani, 2025). While pilots in developed economies demonstrate benefits such as traceability, compliance automation, and faster settlements, they also reveal unresolved legal and interoperability issues, as courts and regulators in most jurisdictions have yet to define the enforceability of blockchain-based contracts and ledger entries (Lofaro, 2024; Rashid, 2025). In Africa, interest in blockchain for transparency and anti-corruption has grown, though regional studies identify barriers including limited digital infrastructure, high implementation costs, inadequate technical capacity, and regulatory uncertainty (Elkoraichi et al., 2025; Adjorlolo, 2025). Smart contracts first conceptualized by Szabo (1997) and popularized through platforms such as Ethereum offer decentralized, self-executing agreements that enhance security and efficiency across sectors, including finance and construction (Xu & Chen, 2021; Schär, 2021; David, 2025).

In Kenya, ongoing digital transformation and e-procurement initiatives create a conducive environment for blockchain adoption; however, challenges persist regarding the legal status of digital signatures, data privacy, and system interoperability with existing treasury and audit frameworks (Benchis, 2025; EPZA, 2023–2025). Against this backdrop, the Export Processing Zones Authority (EPZA) provides a representative case to examine blockchain-enabled smart contracts in managing geographically dispersed procurement activities. This study therefore explores how blockchain technology influences procurement performance at EPZA, assessing its capacity to deliver transparency, efficiency, and accountability while addressing the governance, legal, and infrastructural constraints necessary for scalable adoption in Kenya's public procurement landscape.

Corporate Transparency

Empirical studies find that the use of blockchain promotes open behavior in procurement and supply-chain environments through creating common, time-stamped books of records that reduce information asymmetry between buyers, suppliers, and auditors. For example, Ibrahim's (2024) company-level survey of

firms in Ghana's agricultural and cocoa sectors documented a statistically significant association between blockchain uptake and measured improvements in supply-chain transparency and ethical-sourcing metrics, with respondents recording better audit trails and easier verification of origin (Ibrahim, 2024). Systematic reviews and procurement-focused recent literature similarly conclude that blockchain's distributed ledger can greatly extend external visibility into tender history, supplier certifications, and transaction history though they also note that the benefits of transparency are subject to proper governance like who sees or edits data and the integrity of off-chain data entering the ledger (Kademeteme, 2023; Govindan, 2024). These studies collectively show real transparency benefits in pilot and industry settings but caution that design choices (permissioned vs. permissionless ledgers, access control) determine whether transparency increases accountability or merely shifts where secrecy resides.

Decentralization

Contemporary empirical examinations identify that decentralization is not binary but a choice of design with management implications with full permissionless decentralization improves censorship resistance but worsens compliance, identification setup, and integration with systems of public finance; permissioned/delegated models, however, simplify regulatory conformity but at the cost of sacrificing some of the advantages of decentralizing (Govindan, 2024; Alzoubi, 2024). Quantified empirical research on validator concentration and governance impacts shows that best practices in enterprise and public procurement deployments involve hybrid approaches distributed control through vetted validators (ministries, auditors, supplier associations) to balance transparency with legal and operational command. The work thus calls for evidence-based, calibrated decentralization linked to procurement governance, not maximalist ideology undermining regulatory control.

Performance of Smart Contracts in Procurement Operations

Empirical research examines the impact of self-executing contracts on procurement key performance indicators such as payment cycle time, compliance audits, and dispute frequency. Pilot and field testing (e.g., "Smart Contracts for Supplier Relationship Management," 2024) identified measurable reductions in manual reconciliation and faster conditional payment when verifiable triggers (delivery confirmations, inspection reports) were consistently furnished but also recorded failure modes, ambiguous contract terms, subjective quality ratings, and oracle failures subject to human arbitration or fallback provisions (Yerram, 2024; Cheng et al., 2023). Recent legal studies also note that in the absence of express statutory recognition of smart-contract records and auto-enforcement tools, benefits in execution may be delayed due to issues of enforceability in disputes (Bassan, 2024).

STATEMENT OF THE PROBLEM

Public procurement continues to face chronic challenges of limited transparency, lengthy transaction cycles, and high reconciliation costs that undermine value for money. Emerging reviews and pilot studies show that blockchain technology offers promise in addressing these inefficiencies by enhancing traceability, automation, and data integrity (Govindan, 2024; Bassan, 2024). However, these studies also highlight persistent barriers, including the lack of legal recognition of ledger records, limited oracle reliability for off-chain data, and scalability constraints in high-volume environments. In African contexts, empirical research suggests that blockchain adoption can improve accountability and reduce manipulation across value chains, yet progress is constrained by weak digital infrastructure, limited technical expertise, and regulatory uncertainty (Elkoraichi et al., 2025; Ayeboafo, 2025; Adjorlolo, 2025). The Export Processing Zones Authority (EPZA), which manages multi-site procurements where timely verification and payment are critical to investor confidence, reflects these challenges. Despite Kenya's progress in e-procurement reforms, little empirical evidence exists on the effectiveness and feasibility of blockchain-based smart contracts in public procurement, particularly within EPZA's operational context. This lack of context-specific data presents a managerial dilemma: whether to invest limited institutional resources in blockchain systems whose legal status, integration costs, and practical benefits remain uncertain. Consequently, this study examines the effect of blockchain technology adoption on the performance of smart contracts in EPZA, focusing on how blockchain can automate procurement processes while maintaining compliance, security, and seamless integration within existing institutional frameworks.

OBJECTIVES

i. To examine the effect of corporate transparency on performance of smart contract execution in procurement operations at the EPZA in Kenya.
ii. To analyze the effect of decentralization on the performance of smart contract execution in procurement operations at the EPZA in Kenya.

SIGNIFICANCE OF THE STUDY

The current study provides empirical evidence on the effect of blockchain-enabled smart contracts on procurement performance within a Kenyan public institution context. Focusing on the Export Processing Zones Authority (EPZA), the research offers practical insights for procurement managers seeking reliable information on whether smart contracts can reduce delays, minimize errors, and enhance contract transparency. By analyzing performance indicators such as transaction time, compliance accuracy, and supplier satisfaction, the study helps practitioners assess the operational feasibility of blockchain-based procurement systems and identify the managerial competencies necessary for effective implementation. The findings also guide ICT and procurement departments on integrating blockchain

solutions with existing e-procurement and financial platforms. From a policy perspective, the results offer evidence-based input for Kenya's ongoing digital governance and public procurement reforms.

Institutions such as the Public Procurement Regulatory Authority (PPRA) and the Ministry of ICT can utilize these insights to develop guidelines on legal identity management, data protection, and interoperability standards for smart contract systems in the public sector. Regionally, the study contributes to Africa's growing policy discourse on blockchain regulation by highlighting its potential to enhance transparency, accountability, and public expenditure oversight while balancing innovation with compliance and security imperatives. Theoretically, the study strengthens the empirical linkage between blockchain technology and procurement performance in developing economies by extending the applications of Innovation Diffusion and Transaction Cost Theories. It demonstrates how digital trust mechanisms improve institutional efficiency and offers a contextualized model of blockchain-driven procurement performance that can inform future comparative research across African public agencies.

LITERATURE REVIEW

Theoretical Literature Review

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), developed by Davis (1989), explains how individuals adopt and use new technologies based on perceived usefulness (PU) and perceived ease of use (PEU). PU reflects the degree to which users believe a technology enhances performance, while PEU relates to its perceived simplicity. In the context of blockchain, PU is evident in its ability to improve transaction security, reduce fraud, minimize reliance on intermediaries, and enhance supply-chain transparency through smart contracts (Ayeboafo, 2025; Govindan, 2024; Casino, Dasaklis, & Patsakis, 2019). PEU, however, can hinder adoption due to blockchain's technical complexity, including cryptography and consensus mechanisms, as well as less user-friendly interfaces compared to conventional applications. Efforts to improve usability through intuitive wallets and decentralized applications (dApps) have mitigated some barriers (Kim & Kim, 2021). Additional factors such as trust in the technology and implementing organizations, perceived risk of irreversible transactions, and regulatory uncertainty also influence blockchain adoption (Bassan, 2024; Wüst & Gervais, 2018; Elkoraichi et al., 2025). TAM thus provides a theoretical foundation for examining how blockchain's perceived utility, usability, and associated risks shape user acceptance and support the study's independent variables.

The Diffusion of Innovations Theory

The Diffusion of Innovations (DOI) theory, introduced by Rogers (1962), explains how new ideas, technologies, or practices spread within societies and

organizations through adopter categories: innovators, early adopters, early majority, late majority, and laggards (Rogers, 2003). Applied to blockchain technology in procurement, DOI provides a framework for understanding adoption patterns and organizational behavior. Blockchain's immutable and decentralized ledger enhances transparency, security, and efficiency while addressing common procurement challenges such as fraud, waste, and lack of trust (Saberi et al., 2019). Innovators, such as IBM and Walmart, first experiment with blockchain, demonstrating feasibility and shaping best practices, while early adopters build on these lessons to refine and implement solutions. The early majority requires proven success through pilots, case studies, and clear operational rules before adoption (Queiroz et al., 2019; Bassan, 2024). Adoption is influenced by compatibility with existing procurement processes, system complexity, and testability (Saberi et al., 2019; Kshetri, 2018). Kenya's e-GP system exemplifies DOI stages knowledge, persuasion, decision, implementation, and confirmation showing how systematic awareness, demonstrated benefits, and pilot deployments drive technology adoption and digital transformation in public procurement (Trahan, 2024; Mandala et al., 2024).

Transaction Cost Theory

Transaction Cost Theory (TCT), developed by Coase (1937) and expanded by Williamson (1975), explains how organizations choose between market transactions and hierarchical governance based on costs associated with searching, bargaining, monitoring, and enforcement. In procurement, blockchain technology significantly reduces these transaction costs by eliminating intermediaries, automating contract execution through smart contracts, and providing an immutable, transparent ledger of transactions (Hariyani, 2025; Elkoraichi et al., 2025; Tapscott & Tapscott, 2016). Smart contracts streamline supplier verification, enforce contractual terms automatically, and lower legal, compliance, and monitoring expenses (Lofaro, 2024; Hariyani, 2025). Blockchain also enhances supply chain visibility, enabling real-time tracking, reducing inefficiencies, and improving coordination between stakeholders, which lowers inventory, order fulfillment, and dispute resolution costs (Rashid, 2025). While the technology offers clear cost advantages, adoption challenges remain, including scalability, regulatory uncertainty, and integration with existing systems (Zhao et al., 2019). TCT thus provides a theoretical lens to explain how blockchain reduces procurement transaction costs and enhances operational efficiency.

Resource-Based View Theory

The Resource-Based View (RBV), proposed by Wernerfelt (1984) and developed by Barney (1991), posits that an organization's sustainable competitive advantage stems from unique, firm-specific resources and capabilities that are valuable, rare, inimitable, and non-substitutable (VRIN). Applied to blockchain and smart contracts in procurement, RBV considers digital assets—such as ledger

infrastructures, cryptographic immutability, validator networks, oracle systems, and executable contract templates as strategic resources that can enhance procurement performance through faster payments, stronger audit trails, and reduced fraud risk when managed under VRIN conditions (Jackson, 2024; Govindan, 2024). Blockchain-enabled transparency serves as a relational asset, strengthening credibility with suppliers, auditors, and regulators, while immutability and decentralized validation enhance resilience and governance credibility (Casati et al., 2024; Basile, 2023). The strategic value of these resources, however, depends on robust off-chain data processes, institutional capacity for consensus management, and hybrid permissioned models that align with legal and managerial requirements (Laatikainen, 2023; Punia, 2024). While empirical studies support RBV in explaining digital asset advantages (Jackson, 2024; Casati et al., 2024), criticisms highlight its static nature, limited consideration of ecosystem interdependencies, and difficulty operationalizing VRIN for intangible assets, suggesting RBV should be complemented with dynamic and processual perspectives for emerging technologies (Ontological re-evaluation, 2024; Basile, 2023).

Empirical Literature Review

Corporate Transparency and Performance of Smart Contracts

Empirical studies across Africa indicate that blockchain-based smart contracts can significantly enhance transparency, traceability, and accountability in financial transactions and procurement processes. Okoye et al. (2021) found that smart contracts reduce information asymmetry by storing transactions on immutable ledgers, minimizing fraud and embezzlement, while Mensah and Ofori (2022) highlighted their potential to curb corruption in public procurement, provided appropriate technology and policy frameworks are in place. However, the widespread adoption of blockchain in Africa faces several constraints. Kinyua et al. (2023) and Agyekum et al. (2021) noted a shortage of blockchain expertise, with universities and technical schools offering limited training in blockchain programming and cryptography, leaving firms reliant on costly third-party services. Transaction throughput and high fees, particularly on public blockchains like Ethereum, further limit scalability (Adegbite & Okafor, 2022). Resistance to change, high deployment costs, and integration challenges with existing corporate systems compound adoption barriers (Nkosi & Dlamini, 2020).

Despite these challenges, research confirms positive impacts where blockchain is implemented. Smart contracts improve supply chain management by automating contract enforcement, reducing intermediaries, and enhancing real-time oversight of financial and procurement activities (Ochieng et al., 2023; Saberi et al., 2019). Comparative studies in West African francophone countries show similar benefits but note low adoption due to regulatory uncertainty and limited awareness, emphasizing the need for supportive legal frameworks and cross-sector

collaboration between governments, businesses, and educational institutions (Amadou & Diop, 2021). Collectively, these studies demonstrate that blockchain-based smart contracts have the potential to strengthen corporate governance, reduce corruption, and improve efficiency in Africa, but their effectiveness depends on addressing regulatory, technical, and infrastructural challenges. Future research should prioritize policy development, capacity building, and scalable implementation strategies to facilitate broader adoption across the continent.

Decentralized Blockchain and Performance of Smart Contracts

Recent studies in Kenya and across Africa have examined how blockchain technology, particularly when integrated with decentralized procurement systems, affects the performance of smart contracts and overall procurement efficiency. Ochieng and Muli (2021) conducted a quantitative survey of 150 procurement officers in three Kenyan government agencies and found that blockchain implementation, combined with decentralization, enhances transparency, reduces costs, and accelerates contract execution, though scalability challenges persist. Similarly, Kimani and Njoroge (2022) used a case study approach across five early-adopting departments and reported that decentralized blockchain systems improve efficiency and accountability, but limited technical knowledge and poor internet access in rural areas hinder broader adoption. Otiende and Mwangangi (2023) further demonstrated that decentralization through smart contracts significantly reduces transaction costs by eliminating intermediaries, although enforcement and validation mechanisms remain weak.

Despite these operational benefits, regulatory and legal challenges remain a key constraint in Africa. Ncube and Bessong (2021) highlighted that most African legal frameworks do not yet recognize smart contracts as legally enforceable, and jurisdictional ambiguities complicate cross-border applications. Regulatory uncertainty, fragmented legal systems, and inadequate data protection laws further discourage adoption (Adegbite et al., 2022; Mwangi & Odhiambo, 2020). Legal and cybersecurity risks, including smart contract coding vulnerabilities and lack of dispute resolution mechanisms, add to the complexity (Kanu, 2021; Okeke & Uche, 2022). Additional barriers include skepticism and resistance among business leaders, who often associate blockchain with cryptocurrency risks or fear job displacement due to automation of contract processes (Muthoni & Mwaura, 2022; Adebayo & Ojo, 2021). Infrastructure limitations such as unreliable internet, power outages, and insufficient computing resources further constrain adoption (Okonjo et al., 2023). N

Summary of Research Gaps

Recent studies across Kenya and Africa have explored the impact of blockchain technology, particularly when integrated with decentralized procurement

systems, on smart contract performance and procurement efficiency. Ochieng and Muli (2021) surveyed 150 procurement officers in three Kenyan government agencies and found that blockchain combined with decentralization enhances transparency, reduces costs, and accelerates contract execution, though scalability challenges remain. Kimani and Njoroge (2022), using case studies from five early-adopting departments, reported improved efficiency and accountability, but limited technical knowledge and poor internet access in rural areas hindered wider adoption. Otiende and Mwangangi (2023) demonstrated that decentralized smart contracts significantly reduce transaction costs by eliminating intermediaries, although enforcement and validation mechanisms remain weak. The literature indicates that blockchain-based smart contracts can significantly improve transparency, efficiency, and accountability in African procurement and corporate governance. However, widespread adoption depends on resolving legal recognition, regulatory clarity, technical expertise, and infrastructure challenges. Future research should prioritize scalable implementation strategies, capacity building, and policy development to facilitate blockchain integration across African public and private sectors

CONCEPTUAL FRAMEWORK

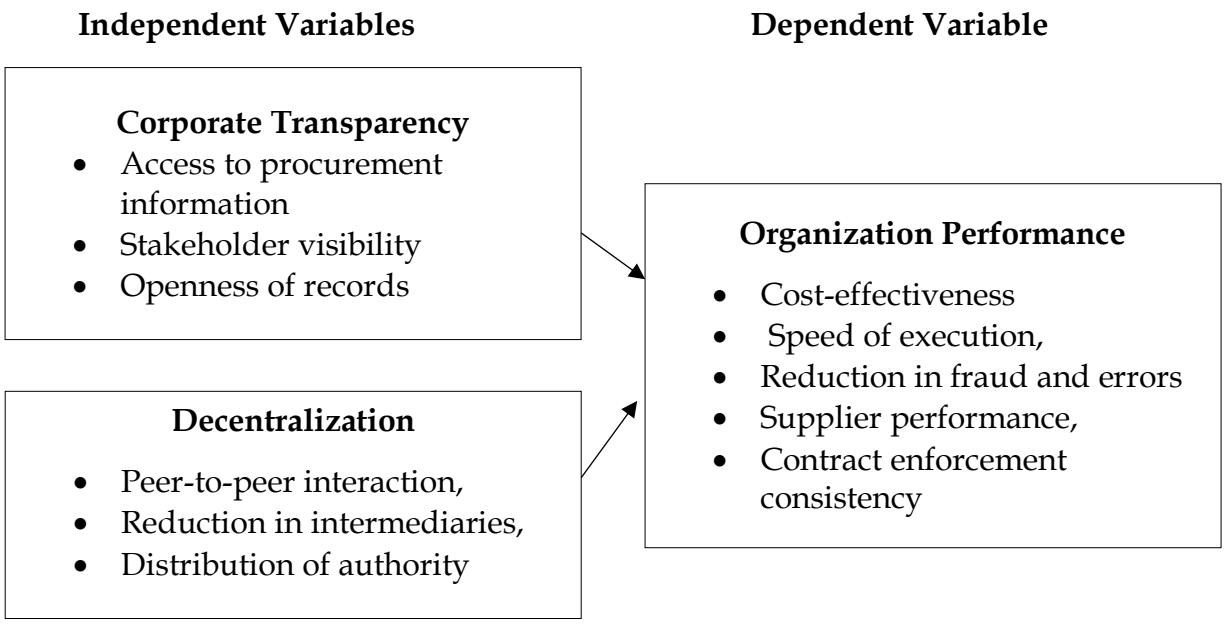

Figure 1: Conceptual framework

METHODOLOGY

Research Design

According to Merriam and Tisdell (2015), research design provides a structured plan that enables the researcher to collect information reflecting real-world conditions, thereby enhancing the validity of findings. This study adopted a descriptive case study design, which allowed for both quantitative measurement of efficiency effects and qualitative exploration of barriers to adoption. This integrated approach provides a comprehensive understanding of the implications of blockchain implementation at EPZA. The design was appropriate for the study objectives, as it enabled examination of the relationship between independent and dependent variables without manipulating them (Seeram, 2019).

Target Population

Oso and Onen (2011) define the target population as the specified group of elements from which a sample is drawn and to which research findings are intended to generalize. For this study, the target population comprised procurement officers, IT staff, finance officers, and compliance personnel across EPZA's three branches in Athi River, Mombasa, and Kisumu. According to EPZA internal staffing records (2024), these branches employ a total of 210 staff involved in procurement and technology-related functions. A stratified sampling approach was used, selecting 30% from each stratum to create a manageable sample for the study. Table 1 presents a detailed breakdown of the target population.

Table 1: Target Population

Category	Population size	Percentage Selected (30%)	Target Population
Athi River Officers	420	30%	126
Mombasa Officers	177	30%	53
Kisumu Officers	103	30%	31
Total	**700**		**210**

Population Stratification

The target officers were stratified by branch as follows: Athi River had 126 officers, Mombasa had 53, and Kisumu had 31. These officers were assumed to possess relevant experience and knowledge regarding blockchain integration in procurement systems.

Sample and Sampling Techniques

A sampling frame refers to the actual set of units from which a sample is drawn, ideally covering the entire population to minimize bias (Kombo & Tromp, 2006). A sampling technique is the procedure used to select individuals or groups for participation in a study (Mugenda & Mugenda, 2019). This study employed

stratified random sampling to ensure representation from each functional category and branch. Stratification was necessary due to the structured composition of the population, ensuring diversity across departments. From the total target population of 210 employees, a sample size of 138 respondents was determined using Yamane's formula (95% confidence level, 5% margin of error). Each stratum including procurement, IT, finance, operations, investor support, and other departments was proportionally represented to reflect its share of the overall population. This technique ensured reliable and generalizable findings.

$$n = \frac{N}{1+N\,(e)^2}$$

Where:

n = required sample size
N = population size = 210
e = margin of error (level of precision) = 0.05

$$n = \frac{210}{1+210\,(0.05)^2} = 138 \text{ officers}$$

Research Instruments

The study collected primary data using structured questionnaires, both digitally via Google Forms and in printed hard copies. The questionnaire included closed-ended and Likert scale items (1 = Strongly Disagree, 5 = Strongly Agree), allowing for the collection of quantitative data while also accommodating qualitative insights. The tool was preferred for its ability to standardize responses across respondents.

Pilot Study

A pilot study was conducted to pretest the questionnaire and ensure its reliability, clarity, and validity. Fourteen respondents were randomly selected from Athi River EPZA, with ten participating in the pilot exercise (Burns & Burns, 2019). Cronbach's Alpha was used to test internal consistency, with a threshold of 0.8. Feedback from the pilot led to revisions in wording, removal of ambiguous items, and alignment with the study variables (Cooper & Schindler, 2020).

Validity of the Research Instrument

Validity measures how accurately an instrument captures the intended concepts (Cooper & Schindler, 2020). The study assessed: Construct validity: Ensured the operational definitions reflected theoretical concepts. Content validity: Reviewed by supervisors to ensure all research variables were included. Face validity: Verified by management experts to confirm that the questionnaire assessed the intended information accurately.

Reliability of the Research Instrument

Reliability refers to the consistency of measurement (Burns & Burns, 2019). Cronbach's Alpha was applied to assess internal consistency. A coefficient above 0.8 was considered excellent, while 0.7–0.8 was satisfactory. The reliability test confirmed that the questionnaire could consistently capture the intended data.

Data Collection Procedure

Primary data were collected using self-administered questionnaires. Hard copies were distributed via drop-and-pick, while digital questionnaires were sent via email and Google Forms to enhance response rates. All respondents received the same set of questions, and no variables were manipulated. Prior to data collection, informed consent and a research permit were obtained from NACOSTI.

Data Analysis and Presentation

Collected data were cleaned, coded, and categorized before analysis using SPSS version 28. Descriptive statistics summarized the data, while correlation and regression analyses established relationships between independent variables (blockchain adoption factors) and the dependent variable (performance of smart contracts). The multiple linear regression model was used to quantify the effects of each independent variable.

Ethical Considerations

Ethical principles were strictly followed throughout the study (Bickman & Rog, 2018): Informed Consent: Letters of consent were obtained from the University, NACOSTI, and EPZA. Participants were fully briefed about the study and voluntarily agreed to participate. Voluntary Participation: Participation was optional, with respondents free to withdraw at any time (Kılınç & Fırat, 2017). Questionnaires avoided personal, offensive, or degrading language (Bordens & Abbott, 2021). Confidentiality: Data were de-identified and securely stored. Only summarized results were publicly shared, ensuring respondents' privacy. Privacy: Personal opinions, views, and information were not disclosed to third parties without consent and were securely stored on password-protected devices (Dawson, 2019). Anonymity: Respondents' identities were protected using pseudonyms and codes. Personal identifiers were not collected on questionnaires, maintaining anonymity throughout the study (Mkandawire, 2019).

FINDINGS

The study investigated the implementation of blockchain technology and the performance of smart contracts in procurement operations at the Export Processing Zones Authority (EPZA) in Kenya. A total of 138 questionnaires were distributed to officers across various departments both online and physically. Of these, 105 questionnaires were duly completed and returned, yielding a response

rate of 77%, which exceeds the 70% threshold generally considered adequate for research validity (Oso & Onen, 2011).

Respondents' General Information

Respondents' demographic information was analyzed to account for potential influences on the study's variables. Prior studies indicate that factors such as gender, age, education, and work experience can impact performance and engagement (Baloshi, 2018). Departmental Distribution: Most respondents were from the Procurement Department (33.3%), followed by Finance (29.5%) and Operations & Investor Support (15.2%). Smaller proportions were from Legal/Compliance (8.6%), ICT (6.7%), and Administration (4.8%), with Compliance & Industrial Relations contributing the fewest participants (1.9%). This distribution ensured representation across departments while capturing perspectives from key operational areas. A majority of respondents had between 4 and 6 years of experience (39%), followed by those with over 6 years (35%). Respondents with 1–3 years of experience accounted for 19%, and less than one year represented 7%. This indicates that most participants were experienced professionals capable of providing informed insights into blockchain integration and procurement operations. Interaction with Smart Contracts: The vast majority of respondents (93%) reported direct interaction with smart contracts in their roles, while only 7% had not. This high level of engagement suggests that respondents had practical experience with blockchain-based procurement processes, enhancing the credibility and relevance of their feedback.

Descriptive Statistics for Variables

Corporate Transparency

Table 2: Corporate transparency

	N	Mean	Std. Dev.	Variance	Skewness Statistic	Skewness Std. Error
1.Procurement data is openly accessible to authorized stakeholders.	105	3.67	.948	.899	-.788	.258
2.Smart contracts improve accountability by making processes visible.	105	4.05	.834	.696	-.826	.258
3. Blockchain enhances the openness of procurement records.	105	3.63	1.111	1.235	-.628	.258
4.Transparency through smart contracts has reduced procurement-related fraud.	105	3.99	1.006	1.011	-.959	.258

The study assessed the impact of blockchain technology on corporate transparency in procurement processes. Respondents generally perceived blockchain positively,

particularly regarding the role of smart contracts in enhancing accountability and visibility. Most strongly agreed that smart contracts improve accountability by making processes visible and that blockchain reduces procurement-related fraud. Moderate agreement was observed for statements on data accessibility and openness of procurement records, suggesting that while transparency has improved, challenges in system integration and data-sharing protocols remain. Overall, respondents' views indicated a high level of consensus, with responses skewed toward the positive end of the scale. The findings show that blockchain-based smart contracts enhance transparency, accountability, and efficiency in procurement by reducing fraud and information asymmetry. However, adoption in Africa is hindered by limited expertise, high costs, scalability issues, and resistance to change. Sustainable progress requires investment in skills, infrastructure, regulation, and multi-sector collaboration. Studies by Okoye et al. (2021), Mensah and Ofori (2022), and Nkosi and Dlamini (2020) (Kinyua et al., 2023; Agyekum et al., 2021; Adegbite & Okafor, 2022).

Decentralization

Table 3: Decentralization

	N	Mean	Std. Devi	Variance	Skewness	
					Statistic	Std. Error
1.Blockchain decentralization reduces dependence on intermediaries.	105	3.49	1.066	1.137	-.456	.258
2.Peer-to-peer execution of contracts improves speed and security.	105	3.25	1.193	1.424	-.380	.258
3.Distributed ledgers empower departments to independently verify procurement processes.	105	3.03	.970	.941	.008	.258
4.Decentralized platforms have reduced manipulation in contract approval processes.	105	3.45	1.169	1.366	-.454	.258

Respondents generally agreed that decentralization, a key feature of blockchain technology, positively impacts procurement efficiency, transparency, and autonomy, though its full potential has yet to be realized. The highest agreement was observed for statements highlighting reduced dependence on intermediaries and minimized manipulation in contract approvals, suggesting that blockchain streamlines procurement processes and promotes fairness. Moderate agreement was noted for peer-to-peer execution of contracts and departmental verification of transactions, indicating that system maturity and integration challenges limit the full realization of decentralized benefits. Overall, responses suggest that

decentralization enhances efficiency, accountability, and trust, but further improvements in distributed ledger access and peer-to-peer systems are needed.

These findings are consistent with prior studies. Mwangi and Wambui (2020) observed that decentralized systems accelerate contract processing and reduce fraud, though infrastructure limitations constrain efficiency. Ochieng and Muli (2021) reported that blockchain implementation coupled with decentralization improves transparency, lowers costs, and speeds up contract execution in Kenyan government agencies. Kimani and Njoroge (2022) found improved efficiency and accountability, but scalability was hindered by limited technical expertise and poor internet access, particularly in rural areas. Otiende and Mwangangi (2023) confirmed that smart contract-based decentralization reduces transaction costs by eliminating intermediaries, though enforcement and validation mechanisms remain weak.

Smart Contract Execution

Table 4: Performance of Smart contract execution

	N	Mean	Std. Dev	Variance	Skewness	
				Statistic	Statistic	Std. Error
1.Smart contracts have improved the speed of procurement transactions.	105	3.38	1.059	1.122	-.276	.258
2.Procurement costs have reduced due to the use of smart contracts.	105	3.49	.938	.881	-.717	.258
3.The rate of procurement errors or disputes has decreased.	105	3.44	1.042	1.086	-.333	.258
4.Supplier performance is better monitored and enforced using smart contracts.	105	2.71	1.109	1.230	.229	.258

Respondents generally agreed that smart contract execution, as a component of blockchain technology, positively influences procurement efficiency, cost reduction, and error minimization, though implementation gaps remain in areas such as supplier performance monitoring. Automation through smart contracts was widely recognized for reducing procurement costs, minimizing errors and disputes, and accelerating transaction speed. However, respondents expressed

less confidence in the ability of smart contracts to effectively monitor and enforce supplier performance, suggesting that follow-up activities may still rely on manual oversight or incomplete system integration. Overall, responses indicate moderate agreement, reflecting that while smart contracts contribute to operational improvements, their full potential is not yet consistently realized across all procurement functions. To maximize benefits, organizations may need to strengthen system integration, real-time data sharing, and supplier management mechanisms.These findings align with prior research. Olanrewaju and Sodiya (2020). Nwankwo and Okonkwo (2021). Moyo et al. (2022) Abebe and Tesfaye (2023) .

Regression Analysis

Table 5: Model Summary for corporate transparency

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.392[a]	.154	.144	.837

a. Predictors: (Constant), corporate transparency

Table 5 shows that corporate transparency has a moderate positive relationship with the dependent variable (R = 0.392). The R^2 value of 0.154 indicates that corporate transparency explains about 15.4% of the variance in procurement performance or blockchain adoption, while the Adjusted R^2 of 0.144 confirms the model's reliability. The standard error (0.837) suggests moderate prediction accuracy. Overall, the results imply that corporate transparency positively influences procurement outcomes, though other blockchain factors also contribute to overall performance.

Table 6: ANOVA[a] for corporate transparency

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.827	1	10.827	15.462	.000[b]
	Residual	59.518	104	.700		
	Total	70.345	105			

a. Dependent Variable: Smart contract execution

b. Predictors: (Constant), corporate transparency

Table 6 presents the ANOVA results testing the effect of corporate transparency on smart contract execution. The analysis shows that the model is statistically significant with an F-value of 15.462 and a p-value of 0.000 ($p < 0.05$). This indicates that corporate transparency has a significant positive effect on smart contract execution. In other words, improvements in transparency such as open access to procurement data and visibility of processes significantly enhance the

effectiveness of smart contract implementation within blockchain-based procurement systems.

Table 7: Regression Coefficients[a] for corporate transparency

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.417	.447		5.408	.000
	Corporate transparency	.425	.108	.392	3.932	.000

a. DV: smart contract execution

Table 7 indicates that corporate transparency has a positive and significant effect on smart contract execution ($\beta = 0.392$, $t = 3.932$, $p = 0.000$). A one-unit increase in transparency results in a 0.425-unit rise in smart contract execution, with a baseline value of 2.417 when transparency is absent. Overall, greater corporate transparency enhances the effectiveness of smart contract implementation in procurement.

Table 8: Model Summary for decentralization

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.507[a]	.257	.248	.784

a. Predictors: (Constant), decentralization

Table 8 reveals a moderate positive relationship between decentralization and the dependent variable ($R = 0.507$). Decentralization explains 25.7% of the variance in the outcome ($R^2 = 0.257$; Adjusted $R^2 = 0.248$), with a standard error of 0.784 indicating moderate predictive accuracy. Overall, the results show that decentralization significantly enhances smart contract execution and procurement performance by promoting distributed control and reducing dependence on intermediaries.

Table 9: ANOVA[a] Results for decentralization

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.051	1	18.051	29.340	.000[b]
	Residual	52.294	104	.615		
	Total	70.345	105			

a. Dependent Variable: Smart contract execution

b. Predictors: (Constant), decentralization

Table 9 shows that the effect of decentralization on smart contract execution is statistically significant (F = 29.340, p = 0.000). This confirms that decentralization positively influences smart contract performance, as reducing reliance on centralized authorities and enhancing distributed verification improves the effectiveness and reliability of procurement processes.

Table 10: Regression Coefficients[a] for decentralization

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	**Std. Error**	**Beta**	**t**	**Sig.**
1	(Constant)	2.542	.306		8.300	.000
	decentralization	.454	.084	.507	5.417	.000

a. Dependent Variable: Smart contract execution

Table 10 shows that decentralization has a positive and significant effect on smart contract execution (β = 0.454, t = 5.417, p = 0.000). This indicates that increased decentralization, through peer-to-peer verification and reduced intermediary reliance, enhances the efficiency and reliability of smart contract implementation in procurement. The constant value (2.542) suggests a baseline level of smart contract activity even without decentralization.

Multivariate Analysis

Table 11: Model Summary Multivariate Analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.656[a]	.430	.402	.699

a. Predictors: (Constant), decentralization, corporate transparency

Table 11 indicates a strong positive relationship between blockchain attributes and smart contract execution (R = 0.656). The model explains 43.0% of the variance (R^2 = 0.430; Adjusted R^2 = 0.402), confirming its reliability. Overall, the combined influence of corporate transparency, immutability, decentralization, and consensus mechanisms significantly improves the efficiency, transparency, and reliability of smart contract execution in procurement systems.

Table 12: ANOVA[a] Results for Model Summary

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	30.246	2	7.562	15.463	.000[b]
	Residual	40.098	103	.489		
	Total	70.345	105			

a. Dependent Variable: smart contract execution
b. Predictors: (Constant), decentralization, corporate transparency

Table 12 shows that the combined model examining corporate transparency and decentralization is statistically significant (F = 15.463, p = 0.000). This indicates that, collectively, blockchain features such as transparency, immutability, decentralization, and consensus mechanisms have a significant positive effect on smart contract execution, enhancing the performance, reliability, and automation of procurement processes.

Table 13: Regression Coefficients[a] for Multivariate Analysis

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.219	.420		2.905	.005
	Decentralization	.169	.088	.193	1.926	.058
	Corporate transparency	.180	.098	.166	1.824	.072

Table 13 shows that decentralization (β = 0.193, p = 0.058) and corporate transparency (β = 0.166, p = 0.072) have positive but marginally insignificant effects on smart contract execution. Nonetheless, all blockchain attributes collectively enhance smart contract performance, with immutability emerging as the most influential factor in strengthening credibility, security, and effectiveness in automated procurement processes.

CONCLUSION AND RECOMMENDATIONS

The study demonstrates that blockchain technology, particularly through the use of smart contracts and decentralization, has significant potential to enhance procurement processes in the Export Processing Zones Authority (EPZA) in Kenya. Respondents indicated that blockchain adoption improves transparency, accountability, operational efficiency, and cost-effectiveness by reducing reliance on intermediaries, minimizing errors and disputes, and automating contract execution. Smart contracts were especially noted for enhancing visibility and reducing opportunities for fraud, while decentralized systems helped promote fairness and autonomy in procurement decisions. The findings also reveal that the full benefits of blockchain are not yet fully realized. Challenges such as limited technical expertise, inadequate digital infrastructure, partial system integration,

and constraints in supplier performance monitoring limit optimal adoption. Legal and regulatory uncertainties, including the lack of recognition of smart contracts, data protection ambiguities, and fragmented policies across African jurisdictions, further constrain implementation. While blockchain-based smart contracts present a promising avenue for improving corporate governance, transparency, and efficiency in public procurement, their effective deployment requires concurrent investments in human capacity, infrastructure, policy frameworks, and system integration. Addressing these challenges will be critical for maximizing the transformative potential of blockchain in Kenya and across African public and private sector procurement operations.

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