

MOSHI CO-OPERATIVE UNIVERSITY

DISSERTATION ABBRIDGMENT

Title:

**“Exploring the Blockchain Technologies and Supply Chain Efficiency in Tanzania:
A Case Of Medical Store Departments in Tanzania”**

Name of Student:

Rehema Denis Kimambo

Name of Supervisor:

Dr. Faustine Panga

Dr. Hamza Malombe

Faculty of Business and Information Sciences

Masters of Procurement and Supply Chain Management

December, 2025

INTRODUCTION

Across the globe, blockchain technology has been gaining traction in several industries recently and has the potential to transform supply chain management completely (Jamil et al., 2019). Estimates suggest that the United States' pharmaceutical industry loses between \$82.0 billion and \$353.3 billion annually due to drug counterfeiting (Miller & Winegarden, 2020). Supply chains can become more efficient, traceable, and accountable using blockchain technology, which enables secure, transparent, and immutable transactions. Blockchain technology holds promise for improving data management, streamlining inventory control, and ensuring the authenticity of pharmaceutical products (Gomasta *et al.*, 2023).

Regionally, many African countries like Egypt, Kenya, and Zambia, concerns over pharmaceutical safety incidents have led to a growing interest in adopting blockchain technology in the supply chain. There is an urgent need for improved accountability and transparency because it is believed that 10% to 30% of medications are counterfeit, particularly in underdeveloped countries (Liu *et al.*, 2023). In Egypt, about 30% of pharmaceutical companies have already adopted blockchain technology to improve product traceability and supply chain transparency, with examples such as Hyperledger Fabric, which offers secure and efficient transactions (Egyptian Ministry of Health, 2021; Moussa *et al.*, 2023). However, challenges including data privacy concerns, regulatory complexities, and resistance to change hinder widespread adoption (Gruchmann *et al.*, 2023).

Tanzania's National Health Strategy 2019-2024 aims to integrate ICT into the healthcare system to improve service delivery and data management. The policy provides a framework for adopting digital solutions that ensure data security, interoperability, and efficiency. In 2019, the Tanzanian government began exploring blockchain technology to improve governance, transparency, and efficiency, with a focus on combating counterfeit medicines in the pharmaceutical sector (URT, 2019). While no large-scale projects were launched at the time, this marked the start of discussions on how blockchain could improve healthcare supply chains, particularly for drug authenticity and traceability (Holl *et al.*, 2024).

By 2020, pilot projects were introduced in collaboration with international tech companies to enhance drug traceability and reduce the presence of counterfeit medicines (Kombe *et al.*, 2019). Tanzania joined the African Blockchain Consortium in 2021 to further explore regional applications of blockchain (Schlecht, Schneider, and Buchwald, 2021). Ongoing efforts aim to

fully integrate blockchain in pharmaceutical supply chains, improving efficiency and transparency in rural healthcare delivery.

Through a cross-sectional study design, out of 360 MSD staffs 189 were involved in a study from departments within MSD, including procurement, production, distribution, and quality assurance. These departments are integral to the implementation of blockchain technology, ensuring its effectiveness and efficiency. Data were collected using interviews and survey questionnaires, and a subsequent analysis with SPSS offered significant insights.

SUMMARY OF FINDINGS

The study found that procurement risk management has a statistically significant influence on project performance, consistent with Mwalukasa and Sallwa (2024), who observed that systematic risk identification and mitigation improve institutional outcomes. In contrast, vendor relationship management and contractual relationships were not statistically significant predictors of project performance. This differs from findings by Celestine and Ndeto (2023) and Ibrahim (2022), who reported strong effects in other project contexts. The discrepancy may reflect contextual factors in Moshi Municipality, such as weak enforcement structures, limited monitoring capacity, and inconsistent vendor engagement, which reduce the predictive power of these variables despite positive perceptions in descriptive data.

Vendor relationship management was highly rated by respondents, with over 90% reporting strong collaboration, frequent communication, and trust between vendors and project teams. Most respondents indicated that vendors delivered on time and met quality standards. Interviews highlighted the role of meetings, regular feedback, and transparency in facilitating project execution. However, regression analysis showed that vendor relationship management accounted for only 6% of performance variation and had no statistically significant effect on project outcomes ($R^2 = 0.06$, $p = .471$). This suggests that, while stakeholders perceive vendor collaboration as beneficial, its direct influence on measurable indicators such as quality, timeliness, and sustainability remains limited.

Procurement risk management, on the other hand, was both highly rated and statistically significant. Over 90% of respondents agreed that risks were systematically identified, mitigation strategies were implemented, and quality assurance measures were embedded in procurement processes. Interviews revealed the use of environmental screening, SWOT analysis, insurance coverage, and regular procurement audits as part of ongoing risk

monitoring. Regression results confirmed a positive and significant relationship between risk management and project performance ($R^2 = 0.091$, $\beta = .302$, $p = .006$), indicating that risk management accounted for 9.1% of observed variation. This establishes it as the strongest and most consistent predictor of public project performance among the procurement practices examined.

Regarding contractual relationships, respondents recognized the importance of contracts: over 80% agreed that vendors met contractual expectations, milestones were monitored, and disputes were resolved through structured procedures. Progress meetings, service level agreements, and performance evaluations supported compliance, though challenges such as ambiguous clauses, delayed approvals, and limited enforcement persisted. Despite these positive perceptions, regression analysis revealed that contractual relationships had no statistically significant effect on project performance. This indicates that while contracts serve as formal governance frameworks, their effectiveness in directly driving project outcomes depends on integration with robust enforcement and monitoring systems.

Overall, public water projects in Moshi Municipality were perceived as performing well in terms of quality, timeliness, and sustainability. Respondents reported that projects met quality standards, adhered to schedules, and incorporated sustainability measures such as maintenance planning and beneficiary usability. However, regression results indicated that only procurement risk management significantly predicted measurable project performance, while vendor and contractual relationships did not. These findings suggest that, although public water projects are generally successful, measurable outcomes are primarily driven by systematic risk management rather than collaboration or contractual mechanisms alone.

CONCLUSION

This study aimed to assess the adoption of blockchain technology for improving pharmaceutical supply chain efficiency at MSD in Tanzania. The findings are presented in line with the three specific objectives, focusing on lead time, cost management, and counterfeit reduction.

Implement blockchain technologies for order management and lead-time management.

The descriptive results indicated high agreement among respondents that blockchain improved order processing speed, reduced follow-ups, and enhanced coordination between departments. However, in the multiple regression model, order management did not show a statistically

significant impact on lead time ($p = 0.237$), suggesting that while perceived as beneficial, its measurable influence may be outweighed by other blockchain components. Interviews supported the idea that order-related delays have historically stalled manual approvals and that a lack of real-time visibility has contributed to this, both of which blockchain has begun to address. These findings imply that order management is perceived as valuable and is also the strongest driver of lead-time performance.

Inventory management blockchain technologies on cost management.

Descriptively, respondents reported that inventory-related waste had declined, and the cost of order processing had improved, indicating strong operational perceptions of blockchain's cost efficiency. However, regression analysis showed that inventory management did not have a statistically significant effect on cost ($p = 0.537$), whereas order management did ($p < 0.001$). This suggests that while inventory systems contribute operationally, their financial impact is still emerging. Interview feedback confirmed this, with informants emphasising that the financial value from blockchain is currently most evident in streamlined ordering rather than stock control.

Quality management blockchain technologies for counterfeit reduction.

Both the descriptive statistics and interviews revealed strong confidence in blockchain's role in enhancing traceability, product authentication, and regulatory compliance. Regression results confirmed statistically significant effects of order management ($p < 0.001$) and inventory management ($p = 0.010$) on counterfeit reduction, while quality management showed a positive but statistically borderline effect ($p = 0.068$). This indicates that blockchain's counterfeit prevention is most effective where ordering processes and data verification are robust, while inventory-related challenges may still require system optimisation. Interviewees noted that blockchain is now essential for quickly identifying and tracing counterfeit risks, an improvement over the manual processes previously in use.

RECOMMENDATIONS

The study provides recommendation in all key findings showing how magnitude of each factor have the blockchain technology and providing what should be done as

Lead time efficiency

To enhance lead time efficiency in the pharmaceutical supply chain, it is recommended that MSD's ICT Unit, in collaboration with Zonal Warehouse Coordinators, deploy a real-time blockchain-based stock visibility dashboard integrated with existing Enterprise Resource

Planning (ERP) and logistics management systems (LMIS). This should include automated reordering thresholds and push notifications for critical stock levels. The ICT Unit should lead the customisation and integration of blockchain APIs with the existing software to ensure interoperability, while Zonal Warehouse Managers oversee implementation at the depot level. Staff training modules on real-time inventory monitoring and system troubleshooting should be conducted quarterly. Additionally, the Quality Assurance Department must develop a centralised, blockchain-based quality data hub for incident logs, enabling faster detection of quality issues and shorter response times to urgent medical supply demands.

Cost management

To optimise cost management, the Finance, Procurement, and Audit Units should adopt blockchain-based smart contracts for supplier evaluation, contract execution, and invoice verification. The Finance Unit should allocate a dedicated budget for integrating smart contract modules into MSD's Procurement Management Information System (PMIS). The Procurement Unit should automate bid evaluations and supplier performance tracking on blockchain, minimising manual interventions and clerical errors. To monitor the fiscal impact, the Planning and Evaluation Unit should establish a quarterly cost-benefit audit framework that focuses on reductions in processing costs, stock wastage, and administrative expenses. Additionally, targeted capacity-building workshops should be conducted to enhance staff proficiency in blockchain-aided procurement and financial accountability.

Counterfeit reduction

To minimise the risk of counterfeit pharmaceuticals, MSD should collaborate with TMDA to establish a National Blockchain-Integrated Product Verification Framework (NBIPVF). TMDA should enforce policy directives mandating the use of blockchain-generated batch codes and tamper-evident QR codes for all registered pharmaceutical products. The ICT and Quality Assurance Units at MSD should deploy a consumer-facing mobile verification app linked to the blockchain ledger, enabling pharmacists and patients to authenticate products instantly. Public awareness campaigns, including digital media, workshops for healthcare workers, and pharmacy-led education programs, should reinforce the importance of using verified products. TMDA, in partnership with MSD, should also conduct supplier compliance audits to ensure that all products entering the supply chain are logged and tracked on the blockchain.

Strategic integration

Blockchain should not be viewed as a mere digital tool but as a core operational enabler. MSD's Executive Management should establish a Blockchain Implementation Task Force, composed of representatives from ICT, Finance, Procurement, Quality Assurance, and Zonal Stores, to oversee phased deployment, KPI tracking (e.g., delivery time, cost per order, counterfeit detection), and continuous system optimisation. Collaboration with TMDA and technology vendors should be formalised through policy frameworks and technical MOUs to ensure sustainability and long-term efficiency.

In summary, blockchain should not be viewed merely as a digital upgrade but as a strategic enabler of supply chain efficiency. A coordinated, multi-stakeholder implementation involving technical teams, quality regulators, finance officers, and frontline logistics staff is essential to maximising its long-term impact on Tanzania's pharmaceutical supply chain.

Policy Implications

The findings of this study carry significant policy implications for Tanzania's public health and pharmaceutical supply systems. First, there is a clear need for national-level digital supply chain policies that formally recognise blockchain as a strategic infrastructure in pharmaceutical logistics. Regulatory bodies such as the TMDA and the Ministry of Health should develop a compliance framework that mandates blockchain-based traceability across the procurement, distribution, and dispensing phases. This will enhance transparency, reduce the risk of counterfeit products, and ensure the integrity of public health delivery.

Secondly, investment in digital infrastructure and human capital is critical. Policymakers must allocate resources for system upgrades, cross-platform interoperability, and capacity-building programs to support full adoption of blockchain tools, particularly in inventory and quality assurance modules. These investments should be coupled with performance monitoring mechanisms that measure not just adoption and operational and financial impact.

Finally, policy directives should encourage public-private collaboration in blockchain implementation. MSD can partner with verified suppliers, local health tech firms, and international development organisations to co-create scalable blockchain ecosystems. This multi-stakeholder approach can accelerate innovation, improve data standardisation, and support Tanzania's broader digital health strategy under the National Digital Health Strategy (2019–2024), reinforcing long-term health system resilience.