

Integrating Blockchain and Artificial Intelligence in Public Sector Accounting: A Framework for Financial Transparency and Data Security

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Abstract

Public sector institutions are responsible for managing public resources and ensuring transparency and accountability in financial reporting. However, many public sector accounting systems, particularly in developing economies, still rely on manual or partially digitized processes that often lead to inefficiencies, delayed reporting, weak audit trails, and increased vulnerability to financial irregularities. As governments increasingly adopt digital transformation strategies, the need for secure and intelligent financial management systems has become more critical. Artificial Intelligence (AI) and blockchain technology have emerged as powerful tools capable of improving data security, transparency, and operational efficiency in digital systems. This study explores the integration of AI and blockchain in public sector accounting to strengthen financial transparency and data integrity. The paper proposes an Integrated Public Sector Accounting Framework that combines digital transaction verification, AI-driven analytics for anomaly detection, and blockchain-based ledger systems for secure and immutable record keeping. The framework also incorporates continuous audit monitoring and real-time financial reporting mechanisms to enhance oversight and accountability. By leveraging the predictive capabilities of AI and the decentralized security features of blockchain, the proposed model aims to reduce fraud risks, improve audit reliability, and strengthen trust in public financial management systems. The study contributes to the growing discourse on secure digital governance and demonstrates how emerging technologies can support more transparent and resilient public sector accounting infrastructures.

Keywords: Artificial Intelligence (AI), Blockchain Technology, Public Sector Accounting, Financial Transparency, Fraud Detection, Digital Governance

1. Introduction

The rapid advancement of digital technologies has significantly reshaped financial management practices across both private and public sector organizations. In recent years, governments and regulatory institutions around the world have placed increasing emphasis on transparency, accountability, and efficiency in public financial management systems. Because public sector institutions manage substantial volumes of financial transactions and taxpayer resources, the reliability and integrity of accounting processes remain essential components of good governance and institutional trust (World Bank, 2021). Consequently, many countries have initiated digital transformation programs aimed at modernizing traditional accounting infrastructures and improving the security, accessibility, and transparency of financial information.

Despite these global developments, a considerable number of public sector institutions, particularly within developing economies, continue to rely on manual or partially manual accounting procedures for financial recording and reporting. Manual accounting environments typically involve paper-based documentation, fragmented record-keeping practices, and

delayed reconciliation processes. Such operational limitations can hinder efficient financial monitoring and weaken internal control mechanisms. Moreover, manual systems may increase the likelihood of human error, financial misreporting, and potential manipulation of accounting records, thereby undermining financial transparency and accountability (Mhlanga, 2022). In the absence of integrated digital infrastructures, auditors and financial managers may also encounter significant difficulties in tracking transactions and verifying financial data, resulting in weak audit trails and limited oversight of public financial activities.

While transitioning from manual accounting systems to digital platforms offers opportunities to improve efficiency and transparency, the digitalization of financial records also introduces new technological challenges. As accounting systems become increasingly digitized, financial databases may become vulnerable to cybersecurity threats, unauthorized access, and potential data tampering if appropriate safeguards are not implemented (Puthal et al., 2022). Recent studies have indicated that financial management systems and digital accounting platforms are increasingly targeted by cyber threats due to the sensitive and high-value nature of the financial data they contain (Al-Sharafi et al., 2023). Ensuring the security, traceability, and integrity of financial information has therefore become a critical concern in the modernization of public sector accounting systems.

Emerging digital technologies such as Artificial Intelligence (AI) and blockchain have attracted growing attention as potential tools for strengthening financial management and enhancing the reliability of accounting systems. Artificial Intelligence has demonstrated considerable potential in automating financial data analysis, identifying anomalous transactions, and supporting intelligent auditing processes through the application of machine learning and predictive analytics techniques (Moffitt & Vasarhelyi, 2022; Kokina & Davenport, 2021). By processing large volumes of financial information, AI-driven systems can assist auditors and financial managers in detecting irregular patterns, monitoring financial activities, and improving the overall accuracy and timeliness of financial reporting.

Blockchain technology, on the other hand, offers a decentralized and immutable ledger structure that records transactions in a transparent and tamper-resistant manner. Once verified and recorded, blockchain transactions cannot easily be altered, thereby creating a secure and traceable record of financial activities. This feature makes blockchain particularly relevant for accounting environments where reliable audit trails and data integrity are essential (Dai & Vasarhelyi, 2021; Kshetri, 2022). Within financial management systems, blockchain-based platforms can strengthen transparency and trust by ensuring that financial records are verifiable and securely maintained across distributed network structures.

The integration of Artificial Intelligence and blockchain technologies presents a promising pathway for the development of secure and intelligent accounting infrastructures. While blockchain can enhance the transparency and integrity of financial records, Artificial Intelligence provides advanced analytical capabilities for monitoring financial transactions, detecting anomalies, and supporting risk management processes. The complementary interaction between these technologies creates opportunities for the development of accounting systems capable of supporting real-time financial monitoring, automated auditing processes, and improved financial oversight (Casino et al., 2021; Al-Sharafi et al., 2023).

However, despite the growing body of research on digital technologies in financial management systems, limited attention has been given to how Artificial Intelligence and blockchain technologies can jointly support the transition from manual accounting processes

to secure digital accounting systems within public sector institutions. This gap is particularly significant in many developing administrative contexts where public institutions are still at early stages of digital accounting adoption and face challenges related to technological infrastructure, cybersecurity preparedness, and system integration.

Against this background, the present study proposes a conceptual framework that integrates Artificial Intelligence and blockchain technologies to enhance financial data security and transparency in public sector accounting systems transitioning from manual to digital processes. The study seeks to examine how these technologies can complement one another in strengthening financial record integrity, improving audit traceability, and supporting more effective financial oversight in public sector institutions.

The remainder of this paper is organized as follows. The next section presents the background and motivation for the study by examining the challenges associated with manual accounting systems and the increasing demand for digital transformation in public financial management. This is followed by a review of existing literature on Artificial Intelligence, blockchain technology, and their applications within accounting and auditing systems. The study then proposes a conceptual framework for integrating AI and blockchain technologies in public sector accounting environments, highlighting key components and potential benefits for financial transparency and data security. Finally, the paper discusses implications for policy and future research and concludes with recommendations for the adoption of secure digital accounting infrastructures in public sector institutions.

2. Background and Motivation

Public sector accounting plays a fundamental role in ensuring that government resources are collected, managed, and utilized in a manner that promotes transparency, accountability, and effective public service delivery. Reliable accounting systems enable governments to track public expenditures, maintain financial discipline, and provide stakeholders with accurate financial information. In developing countries, however, the effectiveness of public financial management often depends heavily on the capacity of accounting systems to support transparent and secure financial record-keeping (Kshetri, 2022; Al-Sharafi et al., 2023).

In Nigeria, as in many developing economies, manual accounting practices remain prevalent across several public sector institutions at federal, state, and local government levels. These systems commonly rely on paper-based ledgers, spreadsheet documentation, and decentralized record-keeping practices. While such approaches have historically supported administrative processes, they often create operational inefficiencies and challenges for financial oversight. Fragmented documentation, limited integration between departments, and delayed reconciliation procedures may hinder the timely preparation of financial statements and weaken the reliability of financial information (Akinola & Ojo, 2022; Obi & Eze, 2021).

The continued reliance on manual accounting systems has important implications for governance and public trust. In contexts where financial accountability is a major concern, the integrity of public financial data becomes critical for maintaining institutional credibility. Weak accounting infrastructures can undermine transparency, complicate auditing procedures, and reduce the effectiveness of financial monitoring mechanisms. As a result, improving the reliability and security of accounting systems has become a key priority for strengthening public financial management in Nigeria and other developing administrative environments (Adebayo et al., 2022).

2.1 Challenges of Manual Accounting in Public Institutions

Manual accounting systems in public institutions present several structural limitations that may affect the quality, transparency, and efficiency of financial management processes.

One major challenge is the high susceptibility to human error. Manual record-keeping depends heavily on human input for data entry, calculations, and reconciliation processes. This reliance increases the likelihood of arithmetic mistakes, incomplete records, or duplicated entries, particularly when large volumes of financial transactions are involved. Reports from public sector audits in Nigeria have frequently highlighted inconsistencies in expenditure records and payroll documentation resulting from manual accounting practices (Obi & Eze, 2021).

Another significant concern relates to limited auditability and weak internal control mechanisms. Paper-based accounting systems often lack comprehensive and traceable audit trails, making it difficult for auditors to verify transactions and identify irregularities. Inadequate documentation and incomplete financial records may create opportunities for financial mismanagement or fraudulent practices, thereby undermining accountability mechanisms within public institutions (Adebayo et al., 2022).

Manual accounting systems also contribute to delays in financial reporting and decision-making. The reconciliation of financial records across departments typically requires extensive manual verification processes, which can significantly slow down the preparation of financial statements and budget reports. Delayed financial reporting limits the ability of policymakers and financial managers to respond promptly to emerging fiscal challenges or to monitor public expenditures effectively (Chukwuma, 2022).

In addition, fragmented data management practices are common in manual accounting environments. Different departments may maintain separate records using independent documentation methods, creating isolated data silos within the organization. Consolidating these records often requires manual cross-verification, which is time-consuming and prone to further inaccuracies. These challenges complicate the generation of consistent financial reports and reduce the overall reliability of financial information (Akinola & Ojo, 2022).

Finally, manual systems provide limited capacity for real-time financial oversight. Because financial transactions are recorded and processed manually, irregularities or discrepancies may remain undetected until external audits are conducted, sometimes long after the transactions have occurred. This lack of continuous monitoring reduces the effectiveness of financial control mechanisms and increases the risk of financial mismanagement within public institutions.

These challenges are often more pronounced at subnational levels of government, where resource constraints, limited technical capacity, and insufficient training may further exacerbate inefficiencies in accounting processes. Local government audit reports in Nigeria frequently highlight discrepancies in expenditure documentation and incomplete financial records associated with manual accounting practices (Obi & Eze, 2021).

2.2 The Push for Digital Transformation in Nigerian Public Finance

In response to these challenges, governments around the world have increasingly embraced digital transformation initiatives aimed at strengthening public financial management systems. Digital accounting platforms and integrated financial management systems enable governments to improve transparency, enhance financial monitoring, and reduce opportunities

for fraud. Countries such as Estonia, Singapore, and South Korea have successfully implemented comprehensive e-government financial management platforms that allow real-time monitoring of public expenditures and improve financial accountability (Kshetri, 2022).

Nigeria has also undertaken several initiatives to modernize its public financial management infrastructure. Among the most notable reforms are the Integrated Payroll and Personnel Information System (IPPIS), which was introduced to automate government payroll processes and reduce the incidence of ghost workers, and the Government Integrated Financial Management Information System (GIFMIS), designed to improve budget execution, expenditure monitoring, and financial reporting across federal ministries and agencies. In addition, the implementation of the Treasury Single Account (TSA) policy has helped centralize government revenues and enhance financial transparency within the federal government.

Despite these important reforms, the adoption of digital financial management systems in Nigeria remains uneven. In many institutions, manual accounting practices continue to coexist with partially digital platforms, creating hybrid systems that may generate inconsistencies in financial records and complicate reconciliation processes. Such hybrid systems can limit the effectiveness of digital reforms and sustain vulnerabilities to errors and financial irregularities (Akinola & Ojo, 2022; Obi & Eze, 2021).

The Nigerian experience therefore highlights the need for more advanced technological approaches that not only facilitate digital accounting processes but also ensure the security, reliability, and transparency of financial data within public sector institutions.

2.3 Emerging Security Threats in Digital Accounting Systems

While digital accounting systems offer significant advantages in terms of efficiency and accessibility, they also introduce new risks associated with cybersecurity and data integrity. As financial records become digitized and interconnected across networks, digital accounting platforms may become vulnerable to unauthorized access, cyberattacks, or manipulation of financial data if adequate security measures are not in place (Puthal et al., 2022).

Financial databases and accounting systems are particularly attractive targets for cybercriminals due to the sensitive and valuable nature of the information they contain. Unauthorized alterations to financial records or breaches of accounting systems can undermine the credibility of financial statements and compromise public trust in government institutions. Research indicates that developing economies often face greater vulnerabilities to digital financial fraud due to limited cybersecurity infrastructure and insufficient technical safeguards (Al-Sharafi et al., 2023).

These emerging risks underscore the importance of developing secure digital accounting systems capable of protecting financial data while maintaining transparency and accessibility for auditing and oversight purposes.

2.4 Motivation for Integrating Artificial Intelligence and Blockchain

In light of the limitations of manual accounting systems and the emerging risks associated with digital financial platforms, there is increasing interest in innovative technological solutions that can strengthen the security and reliability of public sector accounting systems.

Blockchain technology offers a decentralized and tamper-resistant ledger structure that records financial transactions in a secure and transparent manner. Because transactions recorded on a

blockchain cannot easily be altered once verified, the technology provides a reliable mechanism for maintaining immutable financial records and strengthening audit trails. Blockchain-based accounting systems therefore have the potential to enhance transparency and reduce opportunities for financial manipulation within public financial management systems (Dai & Vasarhelyi, 2021; Kshetri, 2022).

Artificial Intelligence, on the other hand, provides advanced analytical capabilities that can support financial monitoring, anomaly detection, and automated auditing processes. AI-driven systems are capable of analyzing large volumes of financial data to identify unusual patterns, detect potential irregularities, and support more informed decision-making by financial managers and auditors (Moffitt & Vasarhelyi, 2022; Kokina & Davenport, 2021).

The integration of Artificial Intelligence and blockchain technologies offers a complementary approach to strengthening digital accounting infrastructures. While blockchain can provide secure and transparent financial record-keeping, AI can enhance analytical capabilities by continuously monitoring transactions and identifying potential anomalies. Together, these technologies have the potential to support real-time financial oversight, strengthen auditability, and improve the overall integrity of public sector accounting systems.

The motivation for this study therefore arises from the need to develop a conceptual framework that integrates Artificial Intelligence and blockchain technologies to enhance financial transparency, data security, and accountability in public sector accounting systems transitioning from manual to digital processes. Such a framework can provide valuable insights for policymakers, auditors, and financial administrators seeking to modernize accounting infrastructures and strengthen governance within public financial management systems.

3. Literature Review

The literature review examines the role of emerging digital technologies—particularly Artificial Intelligence (AI) and blockchain—in modern accounting systems, with a specific focus on their relevance for public sector financial management. The review synthesizes insights from existing research across four main areas: (1) Artificial Intelligence in accounting and public sector financial management; (2) blockchain applications in financial record systems; (3) technological approaches to fraud detection and audit enhancement; and (4) digital transformation in government accounting infrastructures. By examining these areas, the review identifies key developments, challenges, and research gaps that inform the development of the conceptual framework proposed in this study.

3.1 Artificial Intelligence in Public Sector Accounting

Artificial Intelligence has increasingly been recognized as a transformative technology capable of improving efficiency and analytical capabilities within accounting systems. AI technologies—including machine learning algorithms, neural networks, and predictive analytics—have demonstrated considerable potential in automating routine accounting tasks, analyzing financial data, and supporting decision-making processes (Moffitt & Vasarhelyi, 2022). In recent years, researchers have highlighted the growing role of AI in modern auditing practices, particularly through the development of continuous auditing systems and intelligent financial monitoring tools.

Within the public sector, accounting processes often remain highly procedural and manual, which can create inefficiencies in financial monitoring and increase the risk of errors or irregularities. AI technologies offer opportunities to address these challenges by enabling

automated analysis of financial transactions and the identification of anomalous patterns in financial data (Kokina & Davenport, 2021). Through machine learning models trained on historical financial records, AI systems can detect deviations from expected patterns and flag potentially suspicious transactions for further investigation.

Several studies have explored the application of AI-driven analytics in financial oversight. For example, machine learning models have been used to detect anomalies in payroll systems, procurement expenditures, and government financial transactions, demonstrating higher detection accuracy compared with traditional rule-based auditing approaches (Nguyen & Nguyen, 2023). These analytical capabilities can significantly enhance the ability of auditors and financial managers to monitor financial activities in large and complex public institutions.

Despite these advantages, the adoption of AI in public sector accounting is accompanied by several practical challenges. One important limitation concerns the availability and quality of financial data. AI systems require structured and digitized datasets for effective analysis, which may be difficult to obtain in institutions where financial records are still maintained through paper-based or fragmented documentation systems. In addition, many public institutions face shortages of personnel with expertise in data analytics and machine learning, which can limit the implementation of AI-based financial monitoring tools (Beg et al., 2024).

Another important concern relates to the interpretability of AI decision-making processes, commonly referred to as the “black box” problem. In public sector accounting environments where transparency and accountability are essential, decision-support systems must provide explanations for their outputs to ensure that financial decisions remain auditable and compliant with regulatory standards (Moffitt & Vasarhelyi, 2022). These considerations highlight the need for complementary technological systems capable of ensuring transparency and integrity in financial records.

3.2 Blockchain Technology in Financial Management

Blockchain technology has emerged as another important innovation with significant implications for accounting and financial record management. A blockchain is essentially a decentralized digital ledger that records transactions in a chronological and immutable structure. Once transactions are verified and added to the ledger, they cannot easily be modified, thereby creating a permanent and tamper-resistant record of financial activities (Dai & Vasarhelyi, 2021).

The characteristics of blockchain, particularly transparency, immutability, and decentralization, make it highly relevant for financial management systems that require strong auditability and data integrity. In accounting environments, blockchain technology can facilitate the creation of secure and verifiable financial records, reducing the risk of data manipulation and strengthening trust in financial reporting processes (Casino et al., 2021).

Several studies have explored the potential applications of blockchain in public financial management. For example, blockchain-based systems can support real-time recording of government financial transactions, allowing multiple stakeholders, including auditors and regulatory authorities, to independently verify financial records. This transparency can improve financial oversight and reduce opportunities for corruption or financial mismanagement (Kshetri, 2022).

Blockchain technology can also facilitate automated compliance processes through the use of smart contracts, which are programmable rules embedded within the blockchain that automatically execute predefined actions when certain conditions are met. In public sector financial management, smart contracts could support automated budget controls, procurement verification processes, and compliance monitoring, thereby improving operational efficiency and accountability.

Nevertheless, several barriers may limit the widespread adoption of blockchain technologies in public sector institutions. These include high infrastructure costs, limited technical expertise, and the absence of comprehensive regulatory frameworks governing blockchain-based financial systems. Additionally, scalability challenges may arise when blockchain networks must process large volumes of financial transactions in real time (Zhang et al., 2024). For these reasons, researchers increasingly emphasize the importance of combining blockchain with other advanced technologies that can enhance its analytical capabilities and operational effectiveness.

3.3 Fraud Detection and Audit Enhancement

Fraud detection remains one of the most significant challenges in public sector financial management, particularly in contexts where manual accounting systems dominate. Traditional auditing practices typically rely on periodic reviews and sample-based transaction verification. While these approaches can identify certain irregularities, they may not be sufficiently effective in detecting complex or large-scale financial anomalies within extensive datasets (Obi & Eze, 2021).

Artificial Intelligence offers a more proactive approach to fraud detection by enabling continuous monitoring of financial transactions. Advanced machine learning models can analyze large volumes of accounting data to identify unusual patterns that may indicate fraudulent activities or financial misreporting. Both supervised learning methods, trained on previously identified fraud cases and unsupervised learning approaches designed to detect unusual behavior without predefined labels have demonstrated effectiveness in identifying financial anomalies (Nguyen & Nguyen, 2023).

Recent empirical research has shown that AI-based systems can significantly improve fraud detection accuracy in financial management systems. Deep learning models, for example, have been applied to analyze government expenditure datasets and identify suspicious patterns in procurement and payroll transactions. These models are capable of identifying subtle anomalies that may not be easily detected through conventional auditing procedures (Chen et al., 2024).

Blockchain technology complements AI-driven fraud detection by ensuring the integrity of financial transaction records. Because blockchain ledgers maintain immutable records, once financial transactions are verified and recorded, they cannot easily be altered or deleted. This immutability strengthens audit trails and ensures that financial records remain reliable and verifiable throughout the auditing process (Dai & Vasarhelyi, 2021).

The combined application of AI-based analytics and blockchain-based record systems therefore provides a powerful approach for improving fraud detection and strengthening financial accountability within public sector accounting systems.

3.4 Digital Transformation in Public Sector Accounting

Digital transformation has become a central priority in public financial management reform efforts worldwide. Governments increasingly recognize the importance of adopting integrated financial management systems capable of supporting efficient financial reporting, real-time monitoring of public expenditures, and improved transparency in government operations (Kshetri, 2022).

Several countries have successfully implemented digital public financial management systems that integrate budgeting, accounting, and financial reporting functions within centralized digital platforms. These systems enable governments to track financial transactions more effectively, reduce administrative inefficiencies, and improve financial oversight.

Nigeria has also undertaken several initiatives aimed at strengthening digital public financial management. Programs such as the Integrated Payroll and Personnel Information System (IPPIS) and the Government Integrated Financial Management Information System (GIFMIS) have been introduced to automate payroll administration, monitor government expenditures, and improve financial reporting across federal ministries and agencies. In addition, the Treasury Single Account (TSA) policy has enhanced transparency by consolidating government revenues into a centralized account structure.

Despite these reforms, digital adoption within public sector accounting systems in Nigeria remains uneven. In many institutions, manual accounting practices continue to coexist with partially implemented digital systems, creating hybrid financial management environments. Such hybrid systems may generate inconsistencies in financial data, delay reconciliation processes, and sustain vulnerabilities to financial irregularities (Akinola & Ojo, 2022; Obi & Eze, 2021).

These challenges highlight the need for more advanced technological frameworks capable of strengthening both the efficiency and security of digital accounting infrastructures.

3.5 Integration of Artificial Intelligence and Blockchain: Research Gaps

Although both Artificial Intelligence and blockchain technologies have received considerable attention in accounting and financial management research, relatively few studies have examined how these technologies can be integrated to support secure and transparent public sector accounting systems.

Existing literature often examines AI and blockchain independently, with many studies focusing on private sector financial services or corporate accounting applications. Research exploring their combined application within public financial management systems particularly in developing administrative contexts remains limited (Kshetri, 2022; Zhang et al., 2024).

Furthermore, empirical studies examining digital accounting transformation within African public sector institutions are relatively scarce. In many developing economies, public sector accounting systems continue to rely on manual processes or partially digital infrastructures, creating vulnerabilities related to financial data security, audit inefficiencies, and limited transparency.

This gap highlights the need for research that develops integrated technological frameworks capable of addressing both the operational and security challenges associated with the transition from manual to digital accounting systems. Accordingly, this study proposes a conceptual framework that integrates AI-driven financial analytics with blockchain-based

financial record management in order to enhance transparency, strengthen data integrity, and support secure digital transformation within public sector accounting systems.

3.6 Summary of Literature Review

The literature reviewed in this section demonstrates that Artificial Intelligence and blockchain technologies each offer important capabilities for improving accounting systems. AI provides advanced analytical tools for financial monitoring, anomaly detection, and decision support, while blockchain technology offers secure and immutable record-keeping structures that strengthen audit trails and data integrity.

However, the integration of these technologies within public sector accounting systems particularly in developing administrative environments remains insufficiently explored in existing research. This gap underscores the importance of developing integrated technological frameworks capable of supporting secure and transparent digital accounting infrastructures. The conceptual framework proposed in this study seeks to address this gap by exploring how Artificial Intelligence and blockchain technologies can jointly support the transition from manual accounting systems to secure digital financial management platforms.

4. Proposed Framework for Integrating Artificial Intelligence and Blockchain in Public Sector Accounting

4.1 Rationale for the Framework

Public sector accounting systems in many developing economies, including Nigeria, have historically relied on manual processes, paper-based documentation, and fragmented financial reporting structures. While these practices have supported administrative operations for decades, they increasingly struggle to meet modern governance requirements for transparency, accountability, and real-time financial oversight. Manual accounting systems often result in delayed financial reporting, weak audit trails, and increased vulnerability to financial mismanagement or data manipulation (Bulgac, 2020; National Information Technology Development Agency [NITDA], 2022).

In Nigeria, the modernization of public financial management has become an important policy priority. Initiatives such as the Government Integrated Financial Management Information System (GIFMIS), the Treasury Single Account (TSA), and the Integrated Payroll and Personnel Information System (IPPIS) demonstrate ongoing efforts to strengthen financial monitoring and improve the integrity of government financial data. However, despite these reforms, several public institutions continue to operate hybrid accounting systems in which manual processes coexist with partially digital platforms. These hybrid environments can create inconsistencies in financial records and may limit the effectiveness of financial monitoring mechanisms.

Emerging technologies such as Artificial Intelligence (AI) and blockchain provide promising opportunities for addressing these limitations. Blockchain technology offers decentralized and immutable ledger structures that ensure financial records cannot be altered once verified, thereby strengthening data integrity and auditability. Artificial Intelligence, on the other hand, provides advanced analytical capabilities that enable automated anomaly detection, predictive financial analysis, and intelligent auditing processes (Appelbaum et al., 2021; Moffitt & Vasarhelyi, 2022).

Given the complementary capabilities of these technologies, integrating AI and blockchain within public sector accounting systems may significantly enhance financial transparency,

strengthen internal control mechanisms, and improve real-time financial monitoring. In response to these challenges and opportunities, this study proposes an Integrated Public Sector Accounting Framework (IPSAF) designed to guide the transition from manual accounting systems toward a secure, AI-supported, blockchain-enabled financial management infrastructure.

The framework is designed with particular attention to the institutional realities of developing administrative environments, including constraints related to infrastructure capacity, workforce training, and regulatory compliance. By aligning technological innovation with practical governance needs, IPSAF provides a scalable model for strengthening transparency, accountability, and financial data security within public sector accounting systems.

4.2 Overview of the Integrated Public Sector Accounting Framework (IPSAF)

The Integrated Public Sector Accounting Framework (IPSAF) consists of four interconnected components designed to support secure and transparent digital accounting systems. These components operate sequentially yet interactively to ensure reliable financial data capture, intelligent transaction analysis, secure record storage, and continuous financial oversight.

The four core components of the framework are:

1. **Digital Transaction Input and Verification (DTIV)**
2. **AI Analytics Engine (AIAE)**
3. **Blockchain Ledger Security (BLS)**
4. **Continuous Audit and Reporting Dashboard (CARD)**

Together, these components create a layered financial management system that combines secure data infrastructure with intelligent financial analytics. The framework enables public sector institutions to strengthen financial oversight while maintaining transparency and accountability in financial operations.

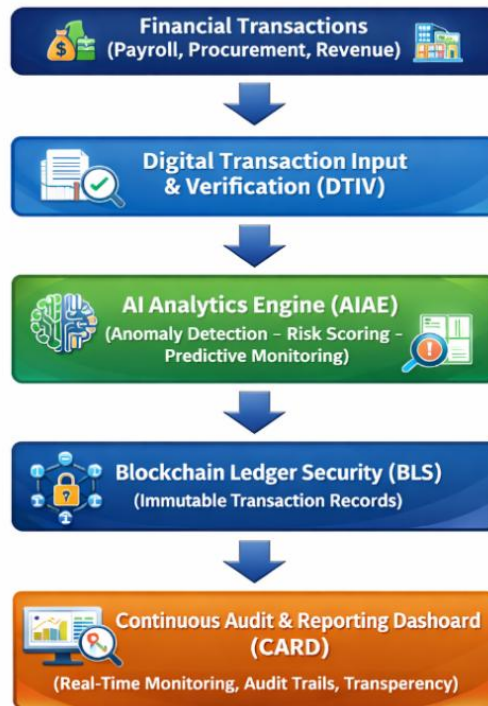


Figure 2: Integrated Public Sector Accounting Framework (IPSAF)

4.3 Core Components of the Framework

4.3.1 Digital Transaction Input and Verification (DTIV)

The Digital Transaction Input and Verification component forms the foundational layer of the IPSAF framework. At this stage, all financial transactions including payroll disbursements, procurement payments, and revenue collections, are captured digitally and subjected to preliminary validation procedures.

This module performs several key functions. First, it ensures data completeness and formatting accuracy by verifying that transaction entries comply with predefined accounting standards and reporting structures. Second, it performs consistency verification, comparing new transaction entries against historical financial records and institutional financial policies. Third, the module facilitates integration with existing financial management systems, allowing institutions to transition gradually from legacy accounting infrastructures to more advanced digital platforms. Accurate data capture is critical because errors introduced during early stages of financial processing may propagate throughout the system, affecting analytical outputs and compromising financial reporting accuracy (Bulgac, 2020). In the Nigerian public sector context, the DTIV module must accommodate diverse financial operations across ministries, departments, and agencies while ensuring standardized reporting practices.

4.3.2 AI Analytics Engine (AIAE)

The AI Analytics Engine represents the analytical core of the proposed framework. Once financial transactions have been validated and recorded digitally, AI-driven analytical tools process the data to identify patterns, assess financial risks, and detect potential anomalies.

Key functions of the AI Analytics Engine include:

- **Anomaly Detection:** Machine learning models analyze financial transaction data to identify irregular activities such as duplicate payments, unusually large expenditures, or deviations from approved budget allocations (Kokina & Davenport, 2021).
 - **Predictive Financial Analytics:** AI models analyze historical financial data to identify trends and forecast potential financial risks, enabling auditors and financial managers to take proactive measures.
 - **Risk Scoring and Prioritization:** Transactions are assigned risk scores based on analytical indicators, allowing auditors to focus on high-risk activities and allocate audit resources more efficiently.
 - **Pattern Recognition:** AI models detect recurring financial irregularities that may indicate systemic weaknesses in internal control systems.
- Empirical research suggests that AI-driven auditing systems can significantly improve fraud detection capabilities and reduce the reliance on manual auditing processes (Appelbaum et al., 2021). In public sector environments where audit teams often face limited human resources, AI-based analytical tools can enhance oversight capacity and improve the timeliness of financial monitoring.

4.3.3 Blockchain Ledger Security (BLS)

Following validation and analytical processing, verified financial transactions are securely recorded within the Blockchain Ledger Security (BLS) component of the framework. Blockchain technology provides a decentralized ledger system in which transaction records are stored across distributed network nodes and secured through cryptographic verification mechanisms.

The blockchain component provides several important benefits for public sector accounting systems:

- **Immutability:** Once transactions are recorded and verified on the blockchain, they cannot easily be altered, ensuring the integrity of financial records.
 - **Distributed Verification:** Multiple network participants validate transactions, reducing the risk of unauthorized alterations.
 - **Smart Contract Execution:** Financial rules and compliance procedures can be embedded within automated smart contracts that execute predefined actions when certain conditions are met.
 - **Transparent Audit Trails:** All financial transactions can be traced through a chronological ledger, improving auditability and strengthening accountability mechanisms.
- International experiences with blockchain-based governance systems demonstrate its potential to strengthen public sector transparency and data security. For example, Estonia has implemented blockchain-based infrastructures to secure government records and improve trust in digital governance systems (Bulgac, 2020).

4.3.4 Continuous Audit and Reporting Dashboard (CARD)

The final component of the IPSAF framework is the Continuous Audit and Reporting Dashboard, which provides real-time financial monitoring and decision-support capabilities for auditors, financial managers, and regulatory authorities.

This module integrates analytical outputs from the AI engine and verified transaction records from the blockchain ledger to generate comprehensive financial oversight tools. Key features include:

- **Interactive Financial Dashboards** that visualize financial flows, budget allocations, and expenditure patterns.
- **Automated Alert Systems** that notify auditors and financial managers of high-risk transactions identified by AI analysis.

- **Comprehensive Audit Trails** that provide verifiable records for both internal and external auditing processes.
 - **Feedback Mechanisms** through which insights from audit reviews can inform future AI analytical models and strengthen institutional financial controls.
- Through these features, the CARD module supports proactive financial monitoring and enables institutions to detect and respond to financial irregularities before they escalate into significant governance challenges.

4.4 Operational Workflow of the Framework

The proposed framework operates through a sequential workflow that integrates digital data capture, intelligent analytics, secure record storage, and continuous financial oversight.

1. Financial transactions are digitally captured and validated through the DTIV module.
2. The AI Analytics Engine analyzes transaction data to detect anomalies and assess risk levels.
3. Verified transactions are recorded within the blockchain ledger to ensure immutability and transparency.
4. The Continuous Audit and Reporting Dashboard provides real-time monitoring and reporting capabilities.
5. Insights from auditing processes feed back into AI models and institutional financial management practices.

The modular design of IPSAF allows institutions to adopt individual components gradually while maintaining compatibility with existing financial management systems.

4.5 Anticipated Benefits of the Framework

The implementation of the proposed framework may provide several benefits for public sector accounting systems:

- **Enhanced Financial Data Security:** Blockchain-based records reduce the risk of unauthorized alterations to financial transactions.
- **Improved Transparency and Accountability:** Real-time monitoring of financial transactions strengthens oversight and public trust.
- **Proactive Fraud Detection:** AI-driven analytics identify suspicious transactions before they escalate into major financial irregularities.
- **Operational Efficiency:** Automation of financial analysis and reporting reduces administrative workload and accelerates financial decision-making.
- **Scalability for National Implementation:** The framework can integrate with existing public financial management systems and expand across multiple levels of government.

By integrating digital accounting infrastructure, AI-based financial analytics, and blockchain-secured record systems, the Integrated Public Sector Accounting Framework provides a comprehensive approach to addressing longstanding challenges in public sector financial management. The framework offers a pathway for strengthening transparency, improving financial oversight, and supporting secure digital transformation in public sector accounting systems in Nigeria and similar emerging administrative environments.

5. Methodology

This study adopts a conceptual research design to develop a framework for integrating Artificial Intelligence and blockchain technologies into public sector accounting systems. Conceptual

research is appropriate in situations where emerging technologies are being examined in relation to existing institutional challenges, particularly when empirical implementation is still limited or evolving (Gilson & Goldberg, 2015).

The methodology is primarily based on systematic analysis and synthesis of existing literature, combined with contextual examination of public financial management practices within Nigeria. Relevant academic publications, policy reports, and institutional documents relating to Artificial Intelligence, blockchain technology, public sector accounting, and digital financial management were reviewed. Sources were selected from peer-reviewed journals, international policy organizations, and scholarly publications to ensure reliability and credibility. The research process followed three main stages.

First, the study conducted a thematic review of literature on the application of Artificial Intelligence and blockchain in accounting and auditing systems. This review identified key technological capabilities, implementation challenges, and emerging governance considerations associated with these technologies. Particular attention was given to studies examining their potential roles in financial monitoring, fraud detection, and secure record management.

Second, the study examined public financial management practices and digital transformation initiatives in Nigeria, including reforms such as the Government Integrated Financial Management Information System (GIFMIS), the Integrated Payroll and Personnel Information System (IPPIS), and the Treasury Single Account (TSA). This contextual analysis provided insight into the current structure of public sector accounting systems and the challenges associated with transitioning from manual accounting processes to digital financial management platforms.

Third, insights from the literature and contextual analysis were synthesized to develop the Integrated Public Sector Accounting Framework (IPSAF) proposed in this study. The framework conceptualizes how Artificial Intelligence and blockchain technologies can interact within a digital accounting infrastructure to improve financial transparency, strengthen audit trails, and enhance data security.

While this study does not involve primary data collection, the conceptual framework provides a theoretical foundation that can guide future empirical research. Subsequent studies may apply the framework through case studies, pilot implementations within public institutions, or quantitative assessments of digital accounting systems.

6. Discussion and Implications

The proposed Integrated Public Sector Accounting Framework provides several important implications for policymakers, financial managers, auditors, and researchers concerned with improving public financial management systems.

First, the framework highlights the potential of emerging technologies to strengthen financial transparency and accountability in government institutions. By combining Artificial Intelligence with blockchain-based record management, public sector accounting systems can move beyond traditional manual reporting structures toward more secure and intelligent financial monitoring environments. This transition may significantly reduce opportunities for financial manipulation while improving the reliability of financial reporting.

Second, the integration of AI-driven analytics can enhance audit efficiency and fraud detection capabilities within public institutions. Traditional auditing methods often rely on periodic reviews and manual verification processes, which may fail to detect irregularities in large datasets. AI-based monitoring systems enable continuous analysis of financial transactions, allowing auditors to identify anomalies and potential risks in real time. Such capabilities may be particularly valuable in resource-constrained environments where audit personnel are limited.

Third, blockchain technology offers a robust mechanism for ensuring financial data integrity and secure record management. The immutability of blockchain-based ledgers strengthens audit trails and ensures that once transactions are recorded, they cannot easily be altered or deleted. This feature is particularly relevant in public sector environments where maintaining the credibility of financial records is essential for both domestic oversight and international financial accountability.

Fourth, the framework emphasizes the importance of institutional readiness and capacity building in the adoption of emerging technologies. Successful implementation of AI and blockchain systems requires adequate technological infrastructure, skilled personnel, and supportive regulatory frameworks. Governments must therefore invest in training programs, digital infrastructure development, and policy frameworks that facilitate secure technological integration.

Finally, the proposed framework contributes to academic discussions on digital transformation in public sector accounting, particularly within developing administrative contexts. While existing studies have examined AI and blockchain separately, the integrated approach proposed in this study highlights the complementary strengths of these technologies in addressing both analytical and security challenges in financial management systems.

7. Conclusion

This study examined the potential role of Artificial Intelligence and blockchain technologies in strengthening public sector accounting systems during the transition from manual accounting processes to secure digital financial management infrastructures. Drawing on existing literature and contextual analysis of public financial management practices, the study proposed the Integrated Public Sector Accounting Framework (IPSAF) as a conceptual model for improving financial transparency, data security, and audit efficiency within government accounting systems.

The findings suggest that manual accounting systems present several limitations, including weak audit trails, delayed financial reporting, and increased vulnerability to financial irregularities. While digital financial management systems offer opportunities to address these challenges, they also introduce new concerns related to cybersecurity and data integrity. Integrating Artificial Intelligence and blockchain technologies provides a promising approach for addressing these challenges simultaneously.

Artificial Intelligence enhances financial monitoring through anomaly detection, predictive analytics, and intelligent auditing capabilities. Blockchain technology strengthens financial record management by providing immutable and transparent transaction ledgers. When combined within a unified digital accounting infrastructure, these technologies can significantly improve financial oversight and support more transparent public financial management systems.

The proposed IPSAF framework therefore provides a conceptual foundation for guiding the digital transformation of public sector accounting systems, particularly in developing administrative environments where manual processes remain prevalent. By integrating secure

digital infrastructures with advanced analytical technologies, public institutions can enhance accountability, strengthen financial governance, and build greater public trust in financial management systems.

Future research may extend this study by empirically testing the proposed framework through case studies or pilot implementations within public sector institutions. Such investigations could provide further insights into the practical challenges, organizational requirements, and long-term benefits associated with the adoption of AI- and blockchain-enabled accounting systems.

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