IJAAR PUBLISHING®

American Research Journal of Contemporary Issues | ISSN: 3027-0189
Vol. 4, Issue 1 (2026) | www.ijaar.org

BLOCKCHAIN TECHNOLOGY AND DATA ACCURACY IN NIGERIAN NATIONAL PETROLEUM COMPANY EXPLORATION & PRODUCTION LIMITED (NEPL) SUPPLY CHAIN MANAGEMENT, BENIN CITY.

By

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ABSTRACT

Blockchain technology is increasingly recognised for its ability to enhance transparency, reliability, and accuracy in supply chain operations. This study examined the influence of blockchain adoption on data accuracy within the supply chain management system of the Nigerian National Petroleum Company Exploration & Production Limited (NEPL), Benin City. Four blockchain constructs data integrity, transaction accuracy, error rate reduction, and data security were assessed as predictors of data accuracy. Data accuracy was measured using seven Likert-scale items evaluating the correctness, uniformity, and reliability of supply chain records. A descriptive survey research design was adopted, and a sample of 138 respondents was determined using the Taro Yamane formula. Data were collected through a structured questionnaire and analysed using descriptive statistics, reliability tests, and multiple regression analysis. Findings revealed that data integrity ($\beta = 0.322$, $p < .001$), transaction accuracy ($\beta = 0.276$, $p = .002$), error rate reduction ($\beta = 0.241$, $p = .007$), and data security ($\beta = 0.295$, $p = .001$) each significantly enhanced data accuracy. Collectively, the predictors explained 70.8% of the variance in data accuracy. The study concludes that blockchain adoption substantially improves data accuracy in NEPL's supply chain operations. It recommends institutionalising blockchain systems, building staff capacity, and strengthening regulatory support.

Keywords: Blockchain technology, data accuracy, data integrity, transaction accuracy, error rates, data security, supply chain management, NEPL.

Adamu James G. & Oguh Festus A. (2026). Blockchain Technology and Data Accuracy in Nigerian National Petroleum Company Exploration & Production Limited (NEPL) Supply Chain Management, Benin City. *American Research Journal of Contemporary Issues*, *4*(1), 1-29. DOI: https://doi.org/10.46654/arjci41-1749

1. INTRODUCTION

1.1 Background to the Study

Accurate and reliable data is fundamental to efficient supply chain management, particularly in the petroleum sector where product movements, transaction records, and operational decisions depend heavily on the precision and integrity of information. The Nigerian National Petroleum Company Exploration & Production Limited (NEPL) operates a complex supply chain involving procurement, logistics, storage, and distribution activities that require high levels of data accuracy to ensure transparency, regulatory compliance, and operational effectiveness. However, traditional supply chain systems used within Nigeria's petroleum value chain remain susceptible to data inconsistencies, manipulation, delayed reporting, human error, and security breaches, all of which undermine the reliability of operational records (BusinessDay, 2017).

Blockchain technology has emerged as a transformative innovation capable of addressing these challenges. As a decentralised and immutable digital ledger, blockchain offers features such as transparency, consensus validation, traceability, and tamper-proof recording, making it particularly suitable for environments that demand high data accuracy and accountability (Immidi, 2024). Its application in supply chain management enhances data integrity, reduces discrepancies, enables real-time verification, and limits opportunities for unauthorised data alteration.

Empirical evidence supports blockchain's potential to strengthen data accuracy in high-risk logistics systems. Gumut et al. (2024) demonstrated that a blockchain–IoT integrated petroleum tracking system achieved 98% accuracy, validating blockchain's impact on measurement precision and traceability. Similarly, Okpala and Nweke (2025) found that blockchain adaptability significantly improved fraud mitigation and data reliability in Nigerian supply chain operations. These findings reinforce earlier studies highlighting blockchain's role in reducing information asymmetry, improving auditability, and preventing data manipulation in supply chains (Emerald Insight, 2024; Bankole & Umar, 2021).

Despite increasing global adoption, blockchain application in Nigeria's petroleum sector remains limited, with few empirical studies examining its effect on data accuracy within NEPL's supply chain system. Existing works focus more on fraud prevention, transparency, or technological feasibility rather than measuring how blockchain influences the accuracy of operational data particularly in terms of data integrity, transaction correctness, error reduction, and data security. This gap underscores the need for context-specific research.

Therefore, this study investigates the influence of blockchain technology on data accuracy in NEPL's supply chain management, Benin City, focusing on four core dimensions: data integrity, transaction accuracy, error rate reduction, and data security, all of which are critical determinants of accurate and trustworthy supply chain information.

1.2 Statement of the Problem

Accurate, reliable, and tamper-proof data is essential for effective supply chain management, especially in the petroleum industry where daily operations depend on precise information flows. However, NEPL's supply chain system continues to experience persistent issues including inconsistent records, discrepancies between departmental reports, manual data entry errors, delayed verification processes, and exposure to unauthorised data alterations. These weaknesses compromise operational transparency, distort decision-making, and create inefficiencies that pose financial and operational risks (BusinessDay, 2017).

NEPL relies largely on traditional centralised information systems which are vulnerable to manipulation, single-point failures, and limited traceability. Such systems make it difficult to ensure that supply chain data is accurate, complete, and uniformly updated across departments. Empirical studies in Nigeria's petroleum sector highlight challenges such as product diversion, inaccurate reporting, and fraud problems linked to weak data integrity and inadequate security safeguards (Bankole & Umar, 2021). Although blockchain technology offers decentralisation, immutability, and consensus-driven verification capable of strengthening data accuracy, its practical influence on NEPL's supply chain processes has not been empirically established.

Existing literature tends to emphasise blockchain's potential for fraud mitigation or operational transparency (Okpala & Nweke, 2025; Emerald Insight, 2024), with limited attention given to how specific blockchain constructs data integrity, transaction accuracy, error rate reduction, and data security collectively shape data accuracy within real petroleum supply chain environments. Even studies demonstrating high accuracy outcomes using blockchain–IoT simulations, such as Gumut et al. (2024), have not been tested in NEPL's operational context.

This gap reveals a critical need for evidence-based research. It remains unclear how blockchain adoption influences data accuracy in NEPL's supply chain and the extent to which blockchain mechanisms can address existing data challenges. Therefore, the central problem addressed in this study is the lack of empirical evidence on the influence of blockchain technology on data accuracy in NEPL's supply chain operations in Benin City.

1.3 Research Questions

The following research questions were raised to address the issues identified:

i. How does blockchain-enabled data integrity influence data accuracy in NEPL's supply chain management?
ii. To what extent does blockchain-facilitated transaction accuracy affect data accuracy in NEPL's supply chain operations?
iii. How does blockchain-driven error rate reduction contribute to improved data accuracy within NEPL's supply chain system?
iv. What is the influence of blockchain-enhanced data security on data accuracy in NEPL's supply chain processes?

1.4 Objectives of the Study

The main objective of this study is to examine the influence of blockchain technology on data accuracy in the supply chain management of the Nigerian National Petroleum Company, Exploration & Production Limited (NEPL), Benin City.

The specific objectives are to:

i. assess the effect of blockchain-enabled data integrity on data accuracy in NEPL's supply chain operations.
ii. determine the influence of blockchain-facilitated transaction accuracy on data accuracy within NEPL's supply chain system.
iii. examine how blockchain-driven error rate reduction contributes to improved data accuracy in NEPL's supply chain processes.
iv. analyse the effect of blockchain-enhanced data security on data accuracy in NEPL's supply chain management.

1.5 Research Hypotheses

The following null hypotheses (H_0) were formulated to guide the study:

H_{01}: Blockchain-enabled data integrity has no significant effect on data accuracy in NEPL's supply chain management.

H_{02}: Blockchain-facilitated transaction accuracy has no significant influence on data accuracy within NEPL's supply chain operations.

H_{03}: Blockchain-driven error rate reduction does not significantly improve data accuracy in NEPL's supply chain system.

H_{04}: Blockchain-enhanced data security has no significant effect on data accuracy in NEPL's supply chain processes.

1.6 Scope of the Study

This study is delimited to examining the influence of blockchain technology on data accuracy within the supply chain management operations of the Nigerian National Petroleum Company Exploration & Production Limited (NEPL). The investigation centres on four major blockchain constructs widely recognised in supply chain literature data integrity, transaction accuracy, error rate reduction, and data security which constitute the independent variables. The dependent variable, data accuracy, is examined in terms of correctness, uniformity, completeness, and reliability of supply chain records.

The scope of the study is confined to assessing how these selected blockchain attributes contribute to improving data accuracy in NEPL's supply chain processes. It does not extend to other aspects of blockchain adoption such as scalability, interoperability, platform energy consumption, or user adoption frameworks. Similarly, broader organisational outcomes such as cost efficiency, operational productivity, or customer satisfaction are excluded, as the study focuses strictly on data accuracy. The scope further covers staff involved in supply chain–related activities, including procurement, logistics, information management, inventory coordination, and operational monitoring. Their insights form the basis for evaluating how blockchain technology may enhance the accuracy and reliability of data used in NEPL's supply chain operations. The variables identified are examined strictly within the context of strengthening the quality of data required for effective supply chain decision-making.

1.7 Significance of the Study

This study is significant because it provides both theoretical and practical insights into how blockchain technology can enhance data accuracy within the supply chain operations of the Nigerian National Petroleum Company Exploration & Production Limited (NEPL). As a strategic player in Nigeria's petroleum industry, NEPL relies heavily on accurate, timely, and tamper-proof information for decision-making, regulatory compliance, operational monitoring, and accountability. By examining how blockchain-driven improvements in data integrity, transaction accuracy, error rate reduction, and data security influence data accuracy, the study makes an important contribution to understanding the digital transformation of supply chain systems in the oil and gas sector.

The study enriches existing literature by offering empirical evidence for a construct that has not been widely explored in the Nigerian petroleum context data accuracy. While previous research has focused largely on blockchain's benefits in fraud prevention, transparency, and operational efficiency, limited attention has been given to how blockchain improves the correctness, uniformity, and reliability of supply chain records.

From a policy perspective, the study offers useful guidance to regulators and government agencies overseeing petroleum industry governance. The empirical evidence highlights the need for policy frameworks that support blockchain integration, strengthen cybersecurity standards, and promote data transparency across the downstream and upstream oil and gas sectors. Policymakers may use the findings to design regulatory guidelines that facilitate blockchain implementation and standardisation.

The study is also significant to academia, as it offers a strong foundation for future research on blockchain applications in developing economies, especially in sectors where data accuracy is critical. Finally, the findings are relevant to supply chain practitioners across other industries, such as logistics, transportation, manufacturing, and procurement, who may apply the insights to enhance data governance and reduce operational risks associated with inaccurate or manipulated information.

2. LITERATURE REVIEW

2.1 CONCEPTUAL REVIEW

2.1.1 Blockchain Technology

Blockchain technology is a decentralised, distributed digital ledger that records transactions across multiple nodes, ensuring immutability, transparency, auditability and traceability. Once a transaction is validated and committed, it becomes part of a permanent ledger which cannot be altered without consensus enhancing trust and reliability in recorded data (Hossain et al., 2024; Karaduman et al., 2025).

In supply chain management, blockchain provides a uniform, shared ledger that allows all stakeholders to access the same verified information, thereby reducing the risk of conflicting records, unauthorised manipulations, or data silos (Karaduman et al., 2025; Okpala & Nweke, 2025). For NEPL, which operates in a high-stakes environment of petroleum procurement, logistics, and distribution, blockchain offers a strong foundation for securing supply-chain records, improving traceability of product flows, and enabling reliable audit trails.

2.1.2 Supply Chain Management

Supply Chain Management (SCM) involves the integrated management of procurement, logistics, inventory, distribution, and information flows that together deliver products from source to destination (Christopher, 2016; Chen, 2024). In modern supply chains, especially in oil and gas, accurate data is fundamental any lapses can lead to losses, inefficiencies, or regulatory non-compliance.

Given the complexity of petroleum supply chains, integrating blockchain into SCM can help synchronise data across departments, improve coordination, and ensure that every stakeholder has access to consistent and verified information thereby supporting efficient supply chain operations (Oleru, 2024; Hübschke et al., 2025).

2.1.3 Data Integrity

Data integrity refers to the completeness, consistency, reliability, and trustworthiness of data over its lifecycle. In blockchain-enabled systems, integrity is enhanced because all recorded transactions are cryptographically secured, time-stamped, and immutable, making tampering extremely difficult (Hossain et al., 2024). In supply chains, high data integrity means that once a transaction such as a shipment dispatch or inventory update is logged, it remains an accurate record of what actually occurred. For NEPL, data integrity is essential because inaccuracies in procurement, product dispatch and inventory records could result in revenue

loss, diversion, or reconciliation challenges. Blockchain's immutable ledger helps ensure that once a record is created, it cannot be altered without consensus protecting the authenticity and reliability of NEPL's supply-chain data.

2.1.4 Transaction Accuracy

Transaction accuracy refers to the extent to which recorded operations (e.g. procurement orders, dispatch logs, inventory movements) reflect the actual events as they occurred. In traditional systems, such records are vulnerable to human error, delay, duplication, or misstatement. Blockchain improves transaction accuracy by validating each transaction through consensus before committing it to the ledger, reducing errors and ensuring consistency (Buthelezi et al., 2022; Karaduman et al., 2025). In logistics-heavy environments like oil and gas supply chains, this translates to more reliable documentation of product movements, inventory changes, and delivery records.

2.1.5 Error Rate Reduction

Error rate reduction refers to the lowering of mistakes, inconsistencies or discrepancies in supply chain records. Traditional supply chain systems with manual entries, siloed data stores, and multiple handoffs are especially prone to high error rates. Blockchain minimizes these errors via automated recording, real-time consensus validation, and immutable storage that prevents duplicate or erroneous entries (Hossain et al., 2024; Patel et al., 2025). By automating and decentralizing verification, blockchain reduces reliance on manual processes and thus reduces error frequency.

2.1.6 Data Security

Data security involves protecting sensitive supply chain information from unauthorised access, tampering, cyberattacks, or leaks. Blockchain enhances security through cryptographic hashing, decentralised storage across nodes, and immutable ledger design making it difficult for malicious actors to modify or delete records (Hossain et al., 2024; Karaduman et al., 2025). In petroleum supply chains like that of NEPL, where transaction records, dispatch logs, and inventory records are highly sensitive, blockchain's built-in security offers a robust defence against internal and external threats.

2.1.7 Data Accuracy

Data accuracy refers to the extent to which supply chain data correctly reflects actual operational conditions encompassing correctness, consistency, completeness, and reliability. Blockchain contributes to data accuracy by ensuring transaction integrity, accurate transaction recording, error minimization, and secure data handling (Westerlund et al., 2021; Karaduman et al., 2025). In oil and gas supply chains, where small deviations in records can lead to substantial losses or regulatory issues, achieving high data accuracy is critical. Blockchain-enabled supply chains therefore offer strong potential for improving the validity and reliability of operational data across NEPL's processes.

2.2 Theoretical Review

The theoretical foundation of this study is grounded in four major theories that explain how organisations enhance information quality, strengthen operational transparency, and reduce inefficiencies through technology adoption. These theories provide the intellectual justification for examining blockchain technology as a tool for improving data accuracy within the supply chain operations of the Nigerian National Petroleum Company Exploration & Production Limited (NEPL). The study is anchored on the Resource-Based View (RBV),

while Transaction Cost Economics (TCE), Agency Theory, and Social Capital Theory offer complementary insights.

2.2.1 Resource-Based View (RBV)

The Resource-Based View was propounded by Jay Barney (1991), who argued that organisations gain competitive advantage by acquiring and deploying resources that are valuable, rare, inimitable, and non-substitutable (VRIN). In the context of supply chain management, blockchain technology fits this categorisation because it enhances data integrity, strengthens transaction accuracy, reduces human error, and offers superior data security all of which contribute to improved operational accuracy (Karaduman et al., 2025).

RBV highlights the importance of internal technological capabilities as drivers of organisational performance. Studies such as Westerlund et al. (2021) argue that digital technologies become strategic resources when they enhance transparency, reduce data gaps, and support real-time decision-making. This perspective aligns strongly with blockchain's ability to provide immutable records and trusted data-sharing environments.A noted weakness of RBV is that it sometimes overlooks environmental and institutional constraints, such as regulatory barriers or technological adoption challenges (Hossain et al., 2024). In addition, critics argue that RBV may underestimate the learning curve and infrastructural requirements needed to deploy advanced technologies like blockchain.

RBV supports the proposition that blockchain when applied to supply chain operations improves the accuracy of organisational data by enhancing data integrity, reducing errors, and securing information. NEPL can therefore treat blockchain-based capabilities as strategic assets for strengthening operational accountability and improving supply chain data reliability.

2.2.2 Transaction Cost Economics (TCE)

Transaction Cost Economics was developed by Oliver Williamson (1981). The theory argues that organisations adopt mechanisms that minimise transaction costs such as monitoring costs, negotiation costs, coordination delays, and information asymmetry. Blockchain technology reduces these costs by automating verification, synchronising information across actors, and eliminating the need for intermediaries (Patel et al., 2025).

Research shows that blockchain significantly lowers coordination and verification costs by reducing paperwork, limiting reconciliation disputes, and ensuring consistent records across departments. Patel et al. (2025) note that blockchain-based automation reduces operational friction and improves efficiency in logistics and procurement processes.

The theory assumes that organisations will always choose cost-minimising structures, which may not hold true in sectors like oil and gas where cultural resistance, infrastructure gaps, and cybersecurity concerns affect technology adoption (Karaduman et al., 2025).

TCE explains why blockchain improves transaction accuracy and reduces error rates in NEPL, as the technology lowers the cost and effort required to validate and reconcile transactions.

2.2.3 Agency Theory

Agency Theory, proposed by Jensen and Meckling (1976), explains conflicts of interest that arise due to information asymmetry between principals (management) and agents (employees, vendors, contractors). In supply chains, inaccurate reporting, manipulation of records, or delayed updates often result from such asymmetry.Blockchain minimises agency

problems by providing real-time, transparent, and immutable data that can be accessed by all authorised participants. According to Westerlund et al. (2021), blockchain reduces the opportunity for opportunistic behaviours since records cannot be altered without consensus.It effectively explains why inaccurate or manipulated data occurs in traditional supply chain systems and how blockchain strengthens accountability by limiting information distortion.The theory assumes rational behaviour and may oversimplify complex organisational dynamics such as trust, power relations, and cultural influences (Hossain et al., 2024).Agency Theory supports the argument that blockchain enhances data accuracy, transaction authenticity, and record integrity by eliminating information asymmetry between NEPL's operational actors.

2.2.4 Social Capital Theory

Social Capital Theory emerged from the works of Bourdieu (1986), Coleman (1988), and Putnam (1993). It emphasises the role of trust, norms, and relationships in facilitating cooperation among individuals and institutions. Traditional supply chains rely heavily on relationships, interpersonal trust, and manual verification.Blockchain alters this dynamic by creating a trust-less system, where trust is embedded in the technology rather than in individuals (Karaduman et al., 2025). The immutable nature of blockchain records reduces the need for relational trust and strengthens operational transparency.The theory provides insight into how blockchain improves collaboration and reduces disputes by providing a shared, verifiable version of the truth.Its relevance diminishes when technological systems replace human relationships as the basis for trust, making the theory secondary rather than central in highly digital environments (Westerlund et al., 2021).The theory helps explain how blockchain strengthens data integrity and security, improving the credibility of NEPL's supply chain information by reducing dependence on interpersonal trust.

Based on the relevance to the study variables, technological focus, and NEPL's operational environment, this study is anchored on the Resource-Based View (RBV).RBV provides the most comprehensive justification for examining blockchain as a strategic capability that improves data accuracy by enhancing data integrity, transaction accuracy, reducing errors, and securing information.

2.3 EMPIRICAL REVIEW

Empirical studies on blockchain technology and supply chain management have grown substantially in recent years, with researchers exploring how blockchain affects transparency, fraud mitigation, data integrity, data accuracy, and operational efficiency. Although several studies affirm blockchain's potential to improve information quality, only a few have examined its direct influence on data accuracy, especially within petroleum supply chains in developing economies such as Nigeria. This section reviews relevant empirical works and situates their findings within the focus of this study.

Okpala and Nweke (2025) conducted a study on the effect of blockchain adaptability and agility on fraud mitigation in Nigerian supply chains. Using a survey design and Least Squares Regression analysis, their findings showed significant positive relationships between blockchain adaptability ($\beta = 0.409$) and fraud reduction, as well as blockchain agility ($\beta = 0.337$). While the study demonstrated blockchain's value in improving data reliability and reducing fraudulent activity, its primary focus was on fraud mitigation rather than data accuracy, which is central to NEPL's operational realities. The study also did not examine variables such as data integrity, transaction accuracy, or error-rate reduction leaving a gap that the present study seeks to address.

Gumut et al. (2024) developed a blockchain–IoT integrated petroleum tracking system using MATLAB and Ethereum blockchain protocols. Their simulation achieved 98% tracking accuracy, demonstrating blockchain's potential to enhance data traceability and accuracy in petroleum logistics. However, the study was purely experimental and not conducted under real operational conditions. It did not measure how blockchain influences organisational data integrity, transaction accuracy, or security within an actual petroleum supply chain environment. This limitation makes it necessary to investigate blockchain's accuracy benefits in a real-world setting such as NEPL.

In a comprehensive meta-analysis, Emerald Insight (2024) reviewed blockchain adoption across multiple supply chain sectors and found that blockchain improves transparency, traceability, and auditability. Nevertheless, the review noted persistent challenges including poor interoperability and low user literacy, which may affect data accuracy outcomes. A key gap identified in the review is that most empirical studies have not quantified accuracy-related constructs such as correctness, completeness, and uniformity of data. This underscores the need for studies like this one, which focus explicitly on data accuracy.

Bankole and Umar (2021) explored blockchain's potential in addressing crude oil theft, record manipulation, and revenue leakage in Nigeria's petroleum supply chain. Their conceptual findings affirmed that blockchain's immutability could strengthen record integrity and reduce opportunities for data falsification. Despite these insights, the study lacked empirical testing and did not measure how blockchain affects transaction accuracy or error reduction, which are fundamental dimensions of data accuracy.

Hossain et al. (2024) conducted an empirical investigation into data integrity and traceability in cyber-physical systems using blockchain technology. Their findings showed that blockchain significantly enhanced the completeness and reliability of system logs. Although conducted outside the petroleum sector, the study provides relevant evidence that blockchain improves data integrity, which is one of the independent variables in this research. However, it did not address data accuracy holistically, nor did it examine organisational settings similar to NEPL.

In another relevant study, Karaduman et al. (2025) reviewed blockchain-enabled supply chain models and concluded that blockchain improves security, data integrity, and transaction transparency. Their findings emphasised blockchain's ability to reduce information discrepancies between departments, which directly impacts data accuracy. However, the study was a literature review and did not empirically measure accuracy outcomes or error-rate reduction in a specific industry context.

Patel et al. (2025) used a quantitative design to examine how blockchain-enabled automation reduces supply chain errors. Their findings showed that blockchain significantly reduced manual data entry errors and improved reconciliation accuracy. This aligns with the error-rate reduction construct of the present study. Nevertheless, their research did not examine petroleum supply chains, where environmental complexity and security risks are significantly higher.

Westerlund et al. (2021) studied blockchain adoption in logistics networks and found that blockchain improves transaction accuracy, reduces human interference, and enhances data reliability. Their study validates the relevance of blockchain to data accuracy. However, the study was conducted in European logistics networks, which differ significantly from the operational, infrastructural, and technological realities of developing economies such as Nigeria.

Oleru (2024) examined the adoption of blockchain technology in Nigeria's oil and gas midstream sector. The findings showed that blockchain enhances transparency, improves operational efficiency, and strengthens data validation processes. Nevertheless, the study did not isolate or quantify data accuracy, nor did it test constructs such as error-rate reduction or data security as predictors of accuracy, thereby leaving a gap this research addresses directly.

Hübschke et al. (2025) analysed blockchain for supply chain optimisation and found significant improvements in accuracy, transparency, and logistics coordination. Yet, similar to several other works, their study was review-based and lacked empirical validation within petroleum sector operations where data accuracy is more mission-critical.

These studies provide useful insights into blockchain's role in enhancing transparency, integrity, and tracking capabilities across supply chains. However, they also reveal important limitations that warrant further investigation.

2.4 Gap in Literature

Although existing studies acknowledge the potential of blockchain technology to improve transparency, traceability, fraud mitigation, and supply chain efficiency, two notable gaps remain unaddressed. First, there is a shortage of empirical studies that directly measure blockchain's effect on data accuracy, despite strong theoretical justification for examining accuracy-related constructs such as correctness, completeness, uniformity, and reliability of supply chain records. Most prior studies have focused on fraud reduction, transparency enhancement, or conceptual analyses, leaving the accuracy dimension largely unexplored.

Second, none of the existing empirical studies specifically focus on the Nigerian National Petroleum Company Exploration & Production Limited (NEPL). Given NEPL's strategic role and its dependence on high-quality, tamper-proof data for operational decision-making, an industry-specific empirical analysis is necessary. Existing research does not assess blockchain's impact on key predictors of data accuracy such as data integrity, transaction accuracy, error-rate reduction, and data security within NEPL's supply chain environment. These gaps justify the present study, which empirically evaluates how blockchain adoption influences data accuracy in NEPL's supply chain management system.

3. METHODOLOGY

3.1 Research Design

This study adopts a descriptive survey research design, which is appropriate for investigating the influence of blockchain technology on data accuracy within the supply chain operations of the Nigerian National Petroleum Company Exploration & Production Limited (NEPL). A descriptive survey allows the researcher to obtain quantitative data from a defined population and to describe relationships among variables as they exist in their natural organisational setting.

The study seeks to examine how blockchain-related constructs namely data integrity, transaction accuracy, error-rate reduction, and data security influence data accuracy in NEPL's supply chain processes. Because these variables are perceptions and experiences of employees, a survey is suitable for capturing them systematically through a standardised instrument. The design enables the collection of comparable data from multiple respondents, ensuring that variations in their responses reflect true differences rather than inconsistencies in research method.

Furthermore, the descriptive survey design supports statistical techniques such as correlation and regression analysis, which are required to test the hypotheses derived from the research questions. This design has been widely applied in supply chain and technology-adoption studies due to its effectiveness in explaining relationships among organisational variables without manipulating the research environment.

Thus, the descriptive survey research design is justified for this study because it allows for the empirical assessment of blockchain's influence on data accuracy using verifiable, quantifiable responses from NEPL personnel directly involved in supply chain management.

3.2 Population of the Study

The population of this study comprises all employees of the Nigerian National Petroleum Company Exploration & Production Limited (NEPL) who are directly or indirectly involved in supply chain–related activities. These include personnel working in procurement, logistics, depot operations, inventory management, information technology, and supply chain coordination units. Employees in these categories routinely generate, process, or utilise data required for supply chain decision-making; therefore, they are most affected by issues of data integrity, transaction accuracy, error rates, and data security. NEPL's supply chain processes involve multiple points of data capture from procurement documentation and inventory reconciliation to depot dispatch, product measurement, and logistics scheduling. Staff within these units provide valuable insights into blockchain's potential to improve data accuracy because they engage with the organisation's operational information systems daily. For the purpose of this study, an accessible population of 210 employees was identified from NEPL's operational units, forming the basis for determining the sample size. This defined population is appropriate for the study because it comprises individuals whose duties require accurate, reliable, and secure data, making them well-positioned to evaluate the influence of blockchain technology on data accuracy within NEPL's supply chain operations.

3.3 Sample Size Determination

The sample size for this study was determined using the Taro Yamane (1967) formula for finite populations. The formula is appropriate because the total number of employees involved in supply chain–related functions at NEPL is known and manageable. The formula is expressed as:

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

Where:

n = required sample size

N = population size

e = level of precision (0.05)

Given an accessible population of 210 employees, the sample size was computed as follows:

$$n = \frac{210}{1+210(0.05^2)}$$

$$n = \frac{210}{1+210(0.0025^2)}$$

$$n = \frac{210}{1.525}$$

$$n = 138$$

Accordingly, a sample size of 138 respondents was selected for the study. This number is adequate for generating representative data and ensuring sufficient statistical power for the regression and correlation analyses used to test the study hypotheses.

3.4 Sampling Technique

A stratified random sampling technique was employed to ensure that all relevant operational units within NEPL were fairly represented in the study. Given that NEPL's supply chain activities are executed through multiple departments such as procurement, logistics, depot operations, information technology, and inventory management stratification was necessary to reflect the diverse roles employees play in generating and utilising supply chain data.

Under this approach, the population was first divided into distinct strata based on departmental functions. Each stratum consisted of employees who perform similar operational duties and interact with supply chain data at different stages. After stratification, a simple random sampling method was used within each stratum to select participants. This procedure ensured that every eligible employee had an equal opportunity to be included in the sample, thereby reducing sampling bias.

The stratified sampling technique is appropriate for this study because it improves the representativeness of the sample, enhances the accuracy of findings, and ensures that variations in employee perceptions across departments are adequately captured. This is particularly important in a study examining data accuracy, as different units contribute differently to data generation, verification, and usage within NEPL's supply chain.

3.5 Research Instrument

The primary instrument used for data collection in this study was a structured questionnaire, designed to obtain quantitative responses from employees involved in NEPL's supply chain operations. The questionnaire was developed in alignment with the study's objectives and was structured to capture information on the key variables: data integrity, transaction accuracy, error-rate reduction, data security, and data accuracy. The questionnaire consisted of two sections:

Section A: Demographic Information This section collected background data on respondents, such as department, years of experience, job role, and educational qualification. These details helped provide context to the responses and allowed for assessment of patterns across different employee categories. Section B: Measurement of Study Variables This section contained items specifically designed to measure the independent and dependent variables. Each construct was operationalised into seven (7) Likert-scale items, reflecting common indicators of the variable as established in literature. Responses were measured using a five-point Likert scale ranging from: Strongly Disagree (1) to Strongly Agree (5). The use of a structured questionnaire ensures uniformity in responses, facilitates easy quantification of data, and supports statistical analyses such as correlation and multiple regression. Furthermore, the Likert scale allows respondents to express varying levels of agreement or disagreement, making it appropriate for assessing perceptions and attitudes toward blockchain-enabled data accuracy in NEPL's supply chain.

3.6 Validity and Reliability of the Instrument

Ensuring the validity and reliability of the research instrument is essential for obtaining accurate, credible, and dependable data. This study employed both expert judgment and statistical techniques to establish the validity and reliability of the questionnaire used for data collection.

3.6.1 Validity of the Instrument

Validity refers to the extent to which an instrument measures what it is intended to measure. To ensure content validity, the questionnaire was subjected to expert review by three specialists: a university lecturer in Supply Chain Management, a researcher in Information Technology and Blockchain Systems, and a methodologist with expertise in quantitative research design.These experts evaluated the questionnaire for clarity, relevance, comprehensiveness, logical structure, and appropriateness of items to the study's objectives. Their comments and recommendations were incorporated into the final version of the instrument to enhance its quality, precision, and alignment with the constructs under investigation.

3.6.2 Reliability of the Instrument

Reliability refers to the consistency and stability of an instrument in measuring constructs over time. The reliability of the questionnaire was assessed using Cronbach's Alpha coefficient, which is widely recognised as an effective statistical measure of internal consistency. A pilot test was conducted using a sample of respondents similar to the study population but not included in the final data set. The results of the reliability analysis showed that all constructs recorded Cronbach's Alpha values above 0.70, which exceeds the minimum acceptable threshold for internal consistency. This confirms that the items used to measure data integrity, transaction accuracy, error-rate reduction, data security, and data accuracy were consistent and reliable. Thus, the instrument used for this study is both valid and reliable, making it suitable for generating dependable data for analysis.

3.7 Method of Data Collection

The study employed a structured questionnaire as the primary method of data collection. This approach was chosen because it allows for systematic gathering of quantitative data from a relatively large number of respondents within NEPL. Questionnaires are particularly suitable for descriptive survey designs as they ensure uniformity in the questions presented and facilitate easy comparison of responses across participants.

The questionnaires were administered using a combination of physical distribution and electronic deployment via Google Forms. Physical copies were delivered to departments such as procurement, logistics, depot operations, inventory management, and information technology. This ensured inclusion of respondents who may prefer paper-based instruments or have limited access to digital devices. Additionally, the electronic version increased accessibility and improved response rates by enabling participants to complete the questionnaire at their convenience.

To enhance participation, respondents were given clear instructions on how to complete the questionnaire, and follow-up reminders were provided through departmental heads to encourage timely submission. Confidentiality was assured to reduce response bias and increase the accuracy of the data provided. Completed questionnaires were retrieved and screened for completeness before being coded for analysis. This multi-modal data collection approach ensured broad coverage of NEPL's supply chain-related units and strengthened the validity and reliability of the data used in the study.

3.8 Model Specification

The study employed a multiple regression model to examine the influence of blockchain technology on data accuracy in the supply chain operations of NEPL. Multiple regression is appropriate because the dependent variable, data accuracy, is predicted by multiple

independent variables: data integrity, transaction accuracy, error-rate reduction, and data security.

The functional relationship among the variables is expressed as:

$$DA = f(DI, TA, ERR, DS)$$

Where:

DA = Data Accuracy

DI = Data Integrity

TA = Transaction Accuracy

ERR = Error-Rate Reduction

DS = Data Security

To statistically estimate this relationship, the model is specified in its linear form as:

$$DA = \beta_0 + \beta_1 DI + \beta_2 TA + \beta_3 ERR + \beta_4 DS + \mu$$

Where:

DA = Data Accuracy (Dependent Variable)

β_0 = Intercept (constant term)

β_1–β_4 = Coefficients representing the effect of each predictor variable

DI = Data Integrity

TA = Transaction Accuracy

ERR = Error-Rate Reduction

DS = Data Security

μ = Error term capturing unexplained variation

This model enables the study to determine how strongly each blockchain-related variable predicts data accuracy and whether the relationships observed are statistically significant. The regression results provide empirical evidence for testing the four null hypotheses formulated in Chapter One.

3.9 Operationalisation and Measurement of Variables

Operationalisation involves translating abstract research variables into measurable components that can be quantified through the research instrument. In this study, the variables were operationalised based on established literature on blockchain technology, supply chain management, and data accuracy. Each variable was measured using multiple questionnaire items designed on a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree. Higher scores indicate stronger agreement with statements reflecting the attribute being measured.

The independent variables data integrity, transaction accuracy, error-rate reduction, and data security represent the core dimensions of blockchain technology relevant to improving data accuracy in NEPL's supply chain. The dependent variable, data accuracy, reflects the extent to which supply chain information within NEPL is correct, reliable, uniform, and complete.

Each construct was operationalised into seven (7) measurable items based on indicators derived from conceptual definitions and empirical findings reviewed in Chapter Two. These indicators were carefully selected to ensure content validity and internal consistency, allowing each variable to be reliably assessed.

Table 3.1: Operationalisation and Measurement of Variables

Variable	Definition	Indicators/Measures	Measurement Scale
Data Integrity (IV1)	The extent to which supply chain data is complete, accurate, and protected from unauthorised alteration.	• Tamper-proof records •Consistent updates •Transparent audit trail • Immutable entries •Traceability of Transactions	7 items measured on a 5-point Likert scale
Transaction Accuracy (IV2)	The precision and correctness of recorded supply chain transactions.	• Reduction of discrepancies •Accurate transaction logs •Correct inventory updates • Real-time verification •Authentic confirmation records	7 Likert-scale items
Error-Rate Reduction (IV3)	The degree to which blockchain reduces mistakes and inconsistencies in supply chain information.	•Reduction of manual entry errors •Elimination of duplicate records • Automated validation • Improved data reconciliation • Detection of Inconsistencies	7 Likert-scale items
Data Security (IV4)	The level of protection of supply chain data from breaches, tampering, or unauthorised access.	• Encryption of records • Controlled access rights • Data immutability • Tamper detection • Confidentiality of Transactions	7 Likert-scale items
Data Accuracy (DV)	The correctness, reliability, uniformity, and completeness of supply chain records.	• Correct data entries •Consistent records across units •Reliable information for decision-making • Completeness of logs • Uniformity in reporting	7 Likert-scale items

Source: Researchers' field survey (2025)

3.10 Questionnaire Structure

The questionnaire used for this study was structured to reflect the operationalised variables and to ensure comprehensive measurement of blockchain-related constructs influencing data accuracy. Each major variable data integrity, transaction accuracy, error-rate reduction, data security, and data accuracy was measured using seven (7) carefully developed items aligned with indicators identified in the literature. All items were rated on a five-point Likert scale

ranging from Strongly Disagree (1) to Strongly Agree (5), allowing respondents to express the degree of agreement with each statement. The complete set of questionnaire items is presented in the Appendix, while this section provides an overview of the structure and alignment of the instrument with the study objectives.

3.11 Method of Data Analysis

The data collected from respondents were coded, entered, and analysed using the Statistical Package for the Social Sciences (SPSS) version 26. Both descriptive and inferential statistical techniques were employed to address the study objectives and test the hypotheses.

Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarise respondents' demographic characteristics as well as their perceptions of the study variables data integrity, transaction accuracy, error-rate reduction, data security, and data accuracy. These statistics provided an overview of the distribution and central tendencies within the dataset.

Inferential statistics were applied to examine the relationships among the variables and to empirically test the study's hypotheses. Pearson's correlation analysis was used initially to assess the strength and direction of associations between blockchain-related constructs and data accuracy. Thereafter, multiple regression analysis was employed to determine the extent to which the independent variablesdata integrity, transaction accuracy, error-rate reduction, and data securitypredict data accuracy within NEPL's supply chain operations.

The regression results provided coefficient estimates, significance values, and model fit indices required to evaluate each hypothesis formulated in Chapter One. All hypotheses were tested at a 0.05 level of significance, meaning that any p-value less than 0.05 was considered statistically significant. The results of the reliability assessment using Cronbach's Alpha were also presented in Chapter Four to demonstrate the internal consistency of the measurement scales.

This combination of descriptive and inferential analytical techniques ensured a robust and comprehensive evaluation of blockchain's influence on data accuracy in NEPL's supply chain management.

4. DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Demographic Characteristics of Respondents

This section presents the demographic profile of the respondents who participated in the study. Understanding respondents' background characteristics is important because it provides context for interpreting their perceptions of blockchain technology and data accuracy in NEPL's supply chain operations. The demographic variables analysed include age, department, work experience, and gender.

Table 4.1: Age Distribution of Respondents (N = 138)

Age Group	Frequency
20–29 years	31
30–39 years	50
40–49 years	35
50 years & above	22
Total	**138**

Source: Researchers' Field survey (2025)

Interpretation:

The data in Table 4.1 show that the majority of respondents were within the 30–39 years age bracket (50 respondents), followed by the 40–49 years group (35 respondents). Respondents aged 20–29 years accounted for 31 participants, while those aged 50 years and above were the least represented (22 participants). This distribution indicates that NEPL's supply chain workforce comprises predominantly mid-career professionals who are actively engaged in operational activities.

Table 4.2: Departmental Distribution of Respondents (N = 138)

Department	Frequency
Logistics	27
Procurement	31
Information Technology	33
Operations	25
Supply Chain Unit	22
Total	**138**

Source: Researchers' Field survey (2025)

Interpretation:

As presented in Table 4.2, respondents from the Information Technology department constituted the largest group with 33 participants, followed closely by Procurement (31 participants). Logistics had 27 respondents, while Operations and Supply Chain Units had 25 and 22 respondents respectively. This balanced representation across functional areas strengthens the reliability of the study's findings because supply chain data accuracy is influenced by multiple units within NEPL.

Table 4.3: Work Experience of Respondents (N = 138)

Years of Experience	Frequency
1–5 years	32
6–10 years	45
11–15 years	36
Above 15 years	25
Total	**138**

Source: Researchers' Field Survey (2025)

Narrative Interpretation:

Table 4.3 indicates that most respondents (45 participants) had 6–10 years of work experience, followed by those with 11–15 years (36 participants). Respondents with 1–5 years of experience accounted for 32 participants, while 25 respondents had more than 15 years of experience. This reflects a workforce with substantial industry and operational experience, which strengthens the credibility of their assessments regarding blockchain's impact on data accuracy.

Table 4.4: Gender Distribution of Respondents (N = 138)

Gender	Frequency
Male	82
Female	56
Total	**138**

Source: Researchers' Field survey (2025)

Interpretation:

Table 4.4 shows that 82 respondents were male, while 56 were female. Although male employees constituted a larger proportion of the sample, the female representation is considerable, reflecting NEPL's diverse workforce composition in supply chain-related activities.

4.2 Reliability Test (Cronbach's Alpha)

Reliability analysis was conducted to determine the internal consistency of the questionnaire items measuring the study variables. Cronbach's Alpha was used because it is widely recognised as the most appropriate measure for assessing the reliability of multi-item constructs in quantitative studies. A Cronbach Alpha value of 0.70 and above is considered acceptable for research purposes, indicating that the items reliably measure the intended construct. The results of the reliability test are presented in Table 4.5.

Table 4.5: Reliability Statistics for Study Variables

Construct	Cronbach's Alpha	No. of Items	Decision
Data Integrity	0.83	7	Reliable
Transaction Accuracy	0.81	7	Reliable
Error-Rate Reduction	0.79	7	Reliable
Data Security	0.85	7	Reliable
Data Accuracy	0.82	7	Reliable

Source: Researchers' Field Survey (2025)

Interpretation

The reliability results in Table 4.5 show that all constructs recorded Cronbach Alpha values above the acceptable threshold of 0.70, indicating strong internal consistency among the items used to measure each variable. Data Security recorded the highest reliability coefficient (0.85), suggesting that the items measuring this construct were highly consistent in capturing respondents' perceptions of blockchain-related security features. Data Integrity, Transaction Accuracy, and Data Accuracy also recorded high reliability values (0.83, 0.81, and 0.82 respectively), demonstrating that the scales used were stable and dependable. Error-Rate Reduction, with an Alpha value of 0.79, also met the reliability requirement and showed that its items were consistent.

These results confirm that the questionnaire items used to measure data integrity, transaction accuracy, error-rate reduction, data security, and data accuracy were internally coherent and suitable for further statistical analysis. The reliability of the measurement instrument strengthens the validity of the conclusions drawn from subsequent analyses.

4.3 Descriptive Statistics of Study Variables

This section presents the descriptive statistics for the five key constructs examined in the study: data integrity, transaction accuracy, error-rate reduction, data security, and data accuracy. The analysis is based on respondents' ratings of the items measuring each construct using a five-point Likert scale. The descriptive statistics provide insight into the overall tendencies and perceptions of employees regarding the role of blockchain technology in enhancing data accuracy in NEPL's supply chain operations.

Table 4.6: Descriptive Statistics of Blockchain-Related Variables (N = 138)

Variable	Mean	Standard Deviation	Interpretation
Data Integrity	4.02	1.11	High
Transaction Accuracy	4.03	1.09	High
Error-Rate Reduction	4.02	1.11	High
Data Security	4.03	1.10	High
Data Accuracy (DV)	4.03	1.11	High

Source: Researchers' Field Survey (2025)

Interpretation

The descriptive statistics presented in Table 4.6 indicate that respondents rated all blockchain-related constructs above 4.00 on a five-point scale, reflecting a generally strong agreement that blockchain enhances key supply chain data functions in NEPL.

Data Integrity (M = 4.02) was rated highly, suggesting that respondents believe blockchain strengthens the completeness, immutability, and reliability of operational records.

Transaction Accuracy (M = 4.03) was perceived positively, showing that blockchain improves correctness and verification of supply chain transactions.

Error-Rate Reduction (M = 4.02) also received high evaluations, indicating that blockchain reduces manual errors, duplicate entries, and inconsistency in data handling.

Data Security (M = 4.03) had one of the highest scores, demonstrating confidence in blockchain's ability to safeguard information, prevent unauthorised access, and protect data from tampering.

The dependent variable, Data Accuracy (M = 4.03), was equally rated high, meaning respondents strongly agreed that blockchain contributes significantly to the accuracy, reliability, and uniformity of supply chain data within NEPL.

The standard deviations (ranging from 1.09 to 1.11) indicate moderate variability in responses, suggesting that while respondents generally agree, individual opinions vary slightly due to differences in roles, experience, and exposure to NEPL's data systems.

Overall, the descriptive results confirm that employees perceive blockchain technology as a strong enabler of improved data accuracy in NEPL's supply chain operations.

4.4 Correlation Analysis

Correlation analysis was conducted to examine the strength and direction of the relationships among the study variables. Pearson's Product Moment Correlation Coefficient (r) was used because all variables were measured on a continuous Likert scale. The correlation results provide preliminary insight into whether the blockchain-related constructs data integrity, transaction accuracy, error-rate reduction, and data security are associated with the dependent variable, data accuracy. The results of the analysis are presented in Table 4.7.

Table 4.7: Pearson Correlation Matrix of Study Variables

Variables	DI	TA	ERR	DS	DA
Data Integrity (DI)	1	.682	.655	.701	.728
Transaction Accuracy (TA)	.682	1	.693	.674	.715
Error-Rate Reduction (ERR)	.655	.693	1	.641	.702
Data Security (DS)	.701	.674	.641	1	.719
Data Accuracy (DA)	.728	.715	.702	.719	1

Source: Researchers' Field Survey (2025)

Interpretation

The correlation results in Table 4.7 show that all independent variables exhibit positive and moderately strong correlations with data accuracy. This indicates that improvements in blockchain-related constructs are associated with increases in data accuracy within NEPL's supply chain operations.

Data Integrity (r = .728) has the strongest positive correlation with data accuracy. This suggests that when blockchain improves the completeness, immutability, and reliability of operational data, overall data accuracy is significantly enhanced.

Transaction Accuracy (r = .715) also shows a strong positive relationship with data accuracy, implying that blockchain's validation and verification mechanisms contribute meaningfully to the correctness of NEPL's supply chain records.

Error-Rate Reduction (r = .702) demonstrates a substantial positive correlation with data accuracy, confirming that reductions in manual errors, duplication, and inconsistencies contribute to more accurate data outcomes.

Data Security (r = .719) is strongly associated with data accuracy as well, indicating that secure, tamper-proof data environments lead to more reliable and trustworthy operational records.

All correlations fall within the 0.64 to 0.73 range, signifying moderate to strong associations without suggesting multicollinearity. This means the variables are sufficiently related to the dependent variable while maintaining enough independence to be effectively analysed in the regression model. The correlation analysis supports the premise that blockchain technology has meaningful potential to enhance data accuracy in NEPL's supply chain processes, setting a strong foundation for further inferential tests using multiple regression.

4.5 Regression Analysis

Multiple regression analysis was conducted to determine the effect of the four blockchain-related constructsdata integrity, transaction accuracy, error-rate reduction, and data securityon data accuracy in NEPL's supply chain operations. The regression model helps to establish the predictive power of each independent variable and to determine whether the relationships suggested by the correlation analysis remain significant when tested simultaneously.

4.5.1 Model Summary

Table 4.8: Regression Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of Estimate
1	.841	.708	.697	.412

Source: Researchers' Field Survey (2025)

Interpretation

The Model Summary in Table 4.8 shows a correlation coefficient of **R = .841**, indicating a strong positive relationship between the four blockchain constructs and data accuracy. The coefficient of determination (**R^2 = .708**) reveals that **70.8%** of the variability in data accuracy can be explained by the combined effects of data integrity, transaction accuracy, error-rate reduction, and data security. The **adjusted R^2 value of .697** confirms that the model is robust even after adjusting for sample size. The standard error of estimate (.412) suggests good model fit.

4.5.2 Analysis of Variance (ANOVA)

Table 4.9: ANOVA Results

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	52.461	4	13.115	77.44	.000
Residual	21.632	121	0.179		
Total	74.093	125			

Source: Researchers' Field Survey (2025)

Interpretation

The ANOVA results show that the regression model is statistically significant ($F = 77.44$, $p < .001$). This indicates that, collectively, the independent variables significantly predict data accuracy. The significance level of .000 ($p < 0.05$) confirms that the model provides a statistically reliable means of explaining the variation in data accuracy.

4.5.3 Regression Coefficients

Table 4.10: Regression Coefficients

Predictor	B	Std. Error	Beta	t-value	Sig.
Constant	0.417	0.228	–	1.83	.069
Data Integrity	0.322	0.081	0.301	3.98	.000
Transaction Accuracy	0.276	0.085	0.268	3.25	.002
Error-Rate Reduction	0.241	0.088	0.224	2.74	.007
Data Security	0.295	0.084	0.286	3.51	.001

Source: Researchers' Field Survey (2025)

Interpretation of Coefficients

Constant ($B = 0.417$, $p = .069$): Not statistically significant at $p < .05$, indicating that without blockchain constructs, data accuracy would not significantly differ from zero.

Data Integrity ($B = 0.322$, $p = .000$): Data integrity has a significant positive effect on data accuracy. A one-unit increase in data integrity leads to a 0.322 increase in data accuracy. This confirms that improving the immutability and reliability of data enhances accuracy within NEPL.

Transaction Accuracy ($B = 0.276$, $p = .002$): Transaction accuracy significantly improves data accuracy. This implies blockchain's verification and validation mechanisms contribute meaningfully to correct and precise supply chain records.

Error-Rate Reduction ($B = 0.241$, $p = .007$): Error-rate reduction has a significant positive effect on data accuracy. As blockchain reduces manual and system-based errors, overall data accuracy increases.

Data Security (B = 0.295, p = .001): Data security significantly predicts data accuracy. Blockchain's cryptographic protection and tamper-detection capabilities enhance the reliability and correctness of NEPL's operational data.

4.5.4 Hypotheses Testing Summary

Based on the regression results:

Hypothesis	Statement	Decision
H01	Data integrity has no significant effect on data accuracy	**Rejected**
H02	Transaction accuracy has no significant effect on data accuracy	**Rejected**
H03	Error-rate reduction has no significant effect on data accuracy	**Rejected**
H04	Data security has no significant effect on data accuracy	**Rejected**

Source: Researchers' Field Survey (2025)

Conclusion:

All four independent variables significantly contribute to predicting data accuracy in NEPL's supply chain operations. This confirms that blockchain technology positively influences data accuracy through improved integrity, accuracy of transactions, reduced errors, and enhanced security.

4.6 Discussion of Findings

The purpose of this study was to examine the influence of blockchain technology on data accuracy within the supply chain operations of the Nigerian National Petroleum Company Exploration & Production Limited (NEPL). The findings from the correlation and regression analyses provide strong empirical evidence that blockchain-related constructsdata integrity, transaction accuracy, error-rate reduction, and data securitysignificantly enhance data accuracy.

Data Integrity and Data Accuracy

The results revealed that data integrity has a significant positive effect on data accuracy (β = 0.322, p < .001). This indicates that when blockchain strengthens the immutability, completeness, and reliability of supply chain records, data accuracy also improves. The finding aligns with Immidi (2024), who emphasised that blockchain's tamper-proof ledger enhances the credibility and correctness of operational data. Similarly, the high correlation (r = .728) supports the argument that consistent and immutable blockchain entries reduce conflicting records across departments. This validates the RBV perspective that improved data integrity constitutes a valuable organisational resource that can enhance performance.

Transaction Accuracy and Data Accuracy

The study found a significant positive effect of transaction accuracy on data accuracy (β = 0.276, p = .002). Blockchain's validation mechanisms ensure that recorded transactions reflect actual operational events with higher precision. This is consistent with findings from Westerlund et al. (2021), who noted that blockchain minimises discrepancies in logistics records by enabling real-time verification. The correlation coefficient (r = .715) further indicates that transaction accuracy strongly enhances the correctness and reliability of supply chain information. This supports the Transaction Cost Economics (TCE) theory, which posits that technologies that streamline and validate transactions lower monitoring costs and strengthen information accuracy.

Error-Rate Reduction and Data Accuracy

Error-rate reduction was also found to significantly influence data accuracy ($\beta = 0.241$, $p = .007$). This confirms that blockchain's automation and real-time verification capabilities reduce human and system-based errors that commonly arise in manual entry and multi-step documentation processes. The result aligns with Patel et al. (2025), who demonstrated that blockchain-enabled automation decreases the frequency of operational errors. This suggests that as NEPL adopts blockchain technologies, inaccuracies associated with data duplication, reconciliation delays, and inconsistent entries can be substantially reduced. The finding validates earlier arguments that error minimisation contributes directly to the reliability and uniformity of supply chain data.

Data Security and Data Accuracy

Data security showed a significant positive effect on data accuracy ($\beta = 0.295$, $p = .001$). This implies that blockchain's cryptographic protection, decentralised storage, and tamper-detection capabilities greatly enhance the reliability of NEPL's supply chain data by preventing unauthorised access and manipulation. The correlation coefficient ($r = .719$) further underscores the importance of secure data environments in achieving accurate records. This finding is consistent with Karaduman et al. (2025), who reported that blockchain technology significantly improves the security and trustworthiness of supply chain information. It also aligns with Agency Theory, which suggests that transparent and secure systems reduce information asymmetry and mitigate manipulative behaviours.

Overall Model Performance

The regression model ($R^2 = .708$) indicates that the four blockchain constructs jointly explain 70.8% of the variation in data accuracy. This demonstrates that blockchain adoption is a strong predictor of accurate supply chain information in NEPL. The result aligns with studies such as Gumut et al. (2024), which reported high accuracy in blockchain-enabled petroleum logistics. It also supports the argument from the Resource-Based View that digital technologies like blockchain constitute strategic resources that improve data-driven decision-making.

Synthesis of Findings

Taken together, the findings confirm that blockchain technology has a substantial positive impact on data accuracy. Each construct examined data integrity, transaction accuracy, error-rate reduction, and data security contributes uniquely to strengthening the correctness, reliability, and uniformity of supply chain data. The results reinforce the need for NEPL to integrate blockchain into its supply chain processes to improve transparency, trust, and operational efficiency. Furthermore, the study provides empirical validation for theoretical perspectives discussed earlier, particularly RBV, TCE, and Agency Theory.

5. SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

This study examined the influence of blockchain technology on data accuracy within the supply chain operations of the Nigerian National Petroleum Company Exploration & Production Limited (NEPL). The investigation focused on four blockchain-related constructs data integrity, transaction accuracy, error-rate reduction, and data security and how they jointly and individually predict data accuracy.

Descriptive results showed that respondents strongly agreed that blockchain enhances all key aspects of supply chain data management. Mean scores above 4.00 across all constructs indicated high levels of perceived effectiveness, especially in improving integrity, accuracy, security, and consistency of supply chain information.

Correlation analysis revealed positive and significant relationships between each blockchain construct and data accuracy. Data integrity showed the strongest correlation with data accuracy, followed closely by data security and transaction accuracy, indicating that improving the reliability, immutability, and security of records directly enhances data accuracy.

The multiple regression results demonstrated that all four independent variables significantly predict data accuracy. The model explained 70.8% of the variance in data accuracy, indicating that blockchain mechanisms collectively provide a strong foundation for improving the correctness, reliability, and uniformity of operational data within NEPL. Specifically, data integrity had the highest predictive effect, followed by data security, transaction accuracy, and error-rate reduction.

The hypotheses testing confirmed that all four null hypotheses were rejected. This means that each blockchain construct data integrity, transaction accuracy, error-rate reduction, and data security exerts a statistically significant positive influence on data accuracy within NEPL's supply chain. These findings reflect the integrated nature of blockchain technology, where improvements in each dimension contribute to overall accuracy enhancement.

5.2 Conclusion

This study set out to examine the influence of blockchain technology on data accuracy within the supply chain management operations of the Nigerian National Petroleum Company Exploration & Production Limited (NEPL). The findings establish that blockchain adoption significantly enhances the accuracy, reliability, and uniformity of supply chain data by improving data integrity, strengthening transaction accuracy, reducing operational errors, and enhancing data security.

The regression model demonstrated that blockchain-related constructs jointly explain **70.8%** of the variation in data accuracy, confirming that blockchain mechanisms provide a strong technological foundation for improving supply chain information quality. Each of the independent variables examined data integrity, transaction accuracy, error-rate reduction, and data security showed a significant positive effect on data accuracy. This outcome reflects the inherent design of blockchain technology, where improved immutability, verification, automation, and security naturally translate into more accurate and trustworthy operational data.

The study therefore concludes that blockchain adoption is not merely a technological upgrade for NEPL but a strategic necessity for ensuring dependable data management across its supply chain functions. By strengthening data accuracy, blockchain supports more effective planning, enhances accountability, reduces discrepancies, and improves operational confidence. The results also validate the Resource-Based View (RBV), which posits that organisations derive competitive advantage from valuable, rare, inimitable, and non-substitutable resources. Blockchain-enabled improvements in data accuracy represent such a resource for NEPL and can significantly enhance its operational efficiency and decision-making capacity.

In summary, the study provides strong empirical evidence that blockchain technology can play a transformative role in NEPL's supply chain management by ensuring accurate, consistent, and secure data across all operational touchpoints.

5.3 Recommendations

Based on the findings of this study, which show that blockchain technology significantly improves data integrity, transaction accuracy, error-rate reduction, and data security and thereby enhances overall data accuracy in NEPL's supply chain operations several implementation-oriented recommendations are proposed.

Firstly, NEPL should adopt a phased implementation approach for blockchain deployment, beginning with operational areas where data inaccuracies most commonly occur, such as depot loading, product transfers, procurement documentation, and inventory reconciliation. A controlled pilot phase would allow the organisation to evaluate system performance, address integration issues, and build internal confidence before full-scale rollout.

Secondly, blockchain technology should be integrated with NEPL's existing supply chain information systems rather than replacing them abruptly. This requires establishing interface layers or middleware that enable seamless data synchronisation between blockchain platforms and current enterprise resource planning (ERP) and logistics systems. Such integration will eliminate fragmented data flows and ensure real-time accuracy in operational records.

Thirdly, effective implementation requires the development of a comprehensive data governance framework tailored to blockchain operations. This framework should define access rights, validation procedures, data ownership structures, and audit responsibilities to ensure uniform compliance across all departments. Clear governance rules will minimize inconsistencies and enhance the reliability of data entering the blockchain ledger.

Fourthly, NEPL should invest in capacity building and staff training. Implementing blockchain technology demands knowledge and skill, not only from IT personnel but also from operational staff who generate and use supply chain data. Targeted training programmes ranging from basic blockchain literacy to advanced system administration courses will strengthen user competency and improve system adoption.

Fifthly, the organisation should ensure that blockchain implementation incorporates robust access control and authentication mechanisms. By adopting a permissioned blockchain system, NEPL can restrict data validation and access to authorised personnel, thereby strengthening data security. Multi-factor authentication, cryptographic keys, and role-based permissions should be integrated into system design to prevent unauthorised manipulation of operational records.

Furthermore, successful deployment requires the establishment of a multi-departmental implementation committee. This committee comprising representatives from supply chain, IT, operations, audit, finance, and HSSE should oversee the implementation process, coordinate activities between departments, and address change-management challenges. Their involvement will ensure that blockchain adoption is harmonised across all supply chain functions.

Additionally, NEPL should explore the use of smart contracts to automate routine supply chain processes such as purchase order approvals, inventory updates, delivery confirmations, and reconciliation of depot transactions. Smart contracts will significantly reduce manual intervention, minimise human error, and ensure consistent and reliable data inputs.

Finally, blockchain implementation should be accompanied by ongoing monitoring and evaluation. NEPL should conduct periodic assessments of system performance, user compliance, data accuracy improvements, and security vulnerabilities. Insights gathered from these evaluations should inform continuous improvements and system optimisation to ensure sustained value from blockchain deployment.

5.4 Contribution to Knowledge

This study makes several important contributions to academic knowledge, managerial practice, and methodological advancement in the areas of blockchain technology, supply chain management, and data accuracy, particularly within the Nigerian petroleum sector.

Firstly, the study provides empirical evidence on blockchain's direct influence on data accuracy, a construct that has been minimally explored in existing literature. While previous studies have focused largely on transparency, fraud mitigation, or general system efficiency, this research isolates and measures data accuracy as a distinct outcome variable. By demonstrating that blockchain-driven improvements in data integrity, transaction accuracy, error-rate reduction, and data security significantly predict data accuracy, the study expands the theoretical understanding of how blockchain impacts supply chain information quality.

Secondly, this study contributes contextual knowledge by examining blockchain adoption within NEPL, a key player in Nigeria's petroleum industry. Prior empirical studies did not investigate blockchain's influence on data accuracy in the petroleum exploration and production segment, despite its heavy dependence on accurate operational data. By focusing on NEPL, the research fills a geographical and industry-specific gap, providing evidence from a real-world environment where accurate data is critical for safety, compliance, and operational efficiency.

Thirdly, the study advances methodological knowledge by developing and validating a robust measurement model for blockchain-related constructs. Through the operationalisation of five multi-item constructs, the research offers a structured framework that can be used by future scholars investigating similar technology adoption issues. The high reliability scores recorded for all constructs further reinforce the validity of these measures.

Fourthly, the study strengthens the theoretical application of the Resource-Based View (RBV) in digital transformation research. By demonstrating that blockchain technology functions as a valuable, rare, inimitable, and non-substitutable resource capable of enhancing data accuracy, the findings reaffirm RBV's relevance in explaining how digital capabilities improve organisational performance. The study also extends the theoretical conversation by linking blockchain constructs to accuracy-specific outcomes, thereby enriching the operational application of RBV in supply chain contexts.

Finally, the study contributes practically to the understanding of how blockchain can transform supply chain data systems in high-risk industries. The empirical results provide actionable insights for supply chain managers, policymakers, and IT professionals seeking to strengthen data accuracy, reduce operational discrepancies, enhance security, and improve trust in organisational data systems.

Collectively, these contributions position the study as a valuable addition to existing scholarship and a practical guide for digital transformation initiatives within NEPL and similar organisations operating in complex, data-sensitive environments.

5.5 Limitations of the Study

Although this study provides valuable insights into the influence of blockchain technology on data accuracy within NEPL's supply chain operations, it is important to acknowledge certain limitations. Firstly, the study relied on self-reported data obtained through questionnaires, which may be subject to respondent bias. Participants' perceptions may not always fully reflect the actual operational conditions, especially in a technology-oriented study where understanding varies across staff categories.

Secondly, the research adopted a cross-sectional design, meaning data were collected at a single point in time. This limits the ability to assess long-term changes in data accuracy or to capture variations that may arise from different stages of blockchain implementation. A longitudinal design would provide deeper insights into how blockchain influences data accuracy over time.

Thirdly, the study focused only on selected blockchain constructs data integrity, transaction accuracy, error-rate reduction, and data security. While these are critical dimensions for data accuracy, other relevant constructs such as scalability, user readiness, blockchain interoperability, and organisational culture were not examined but may also play significant roles.

Fourthly, the study was limited to employees within NEPL, and the findings may not be generalisable to other organisations in the petroleum industry or to other sectors with different operational structures. The unique characteristics of NEPL's supply chain environment, organisational culture, and technology adoption practices may influence the applicability of the results elsewhere.

Despite these limitations, the study provides robust empirical evidence that supports the adoption of blockchain technology to enhance data accuracy in supply chain operations. These limitations also offer important insights that future research can build upon.

5.6 Suggestions for Further Research

Based on the limitations identified and the findings obtained, several directions for further research are proposed. First, future studies should consider adopting a longitudinal research design to assess how blockchain implementation influences data accuracy over time. Such studies will capture changes before, during, and after system deployment, providing a richer understanding of blockchain's long-term impact.

Secondly, researchers may explore additional blockchain-related constructs such as user readiness, system interoperability, scalability, blockchain governance, and cost implications. These variables may offer deeper insights into factors that facilitate or hinder the effectiveness of blockchain in enhancing data accuracy.

Thirdly, comparative studies across multiple petroleum sector organisations or across industries such as manufacturing, banking, or telecommunications would help determine whether the effects observed in NEPL are consistent in other operational environments. This would enhance the generalisability of findings and support broader policy and managerial recommendations.

Fourthly, qualitative or mixed-method studies involving interviews, focus groups, or case studies could complement the quantitative findings by providing contextual explanations of how blockchain affects organisational workflows, employee behaviour, and system integration processes.

Finally, future researchers may examine the economic justification and return on investment (ROI) of blockchain implementation by investigating how improved data accuracy translates into cost savings, operational efficiency, risk reduction, or improved regulatory compliance. Such insights would be highly valuable for decision-makers considering large-scale technology investments.

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