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Effect of Blockchain Technology on Internal Control System of Manufacturing Firms in Nigeria

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ABSTRACT
The main objective of this study was to ascertain the effect of blockchain technology on internal control system of manufacturing firms in Nigeria. The specific objectives were blockchain technology flexibility, blockchain technology adaptability and blockchain technology agility while internal control system was the dependent variable. Three hypotheses were formulated to guide the investigation and the statistical test of parameter estimates was conducted using least squares regression model operated with E-Views.12. Survey design was adopted and data for the study was obtained through the use of questionnaire survey administered to the selected manufacturing firms in Anambra State, Nigeria. The results of the study reveal that blockchain technology flexibility, blockchain technology adaptability and blockchain technology agility have positive and significant effect on internal control system of manufacturing firms in Nigeria. Based on this, the study concludes that blockchain technology enables effective internal control system in manufacturing firms in Nigeria. In lieu of the findings of the study, it was recommended above all that manufacturing firms in Nigeria should consider investing in blockchain technology since the study found that its flexibility enables effective internal control system which improve data security, transparency, and efficiency. Also, successful blockchain technology adaptability in manufacturing firms requires collaboration between different departments within the organization, as well as external stakeholders such as regulators and technology partners. Manufacturing firms should therefore establish a cross-functional teams to drive the blockchain initiative, ensuring that all relevant stakeholders are engaged in the process.
Keyword: Blockchain Technology; Internal Control System; Blockchain Technology Flexibility; Blockchain Technology Adaptability; Blockchain Technology Agility

1. INTRODUCTION

The rapid evolution of blockchain technology has introduced transformative potential across industries, including manufacturing, by offering decentralized, transparent, and immutable systems for recording transactions and managing data. While blockchain is increasingly recognized for its ability to enhance supply chain traceability and cybersecurity, its integration into the internal control systems of manufacturing firms remains underexplored. Internal control systems are critical for ensuring operational efficiency, safeguarding assets, maintaining accurate financial reporting, and complying with regulatory standards (Wang et al., 2022). However, the adoption of blockchain technology may disrupt traditional control mechanisms, introducing both opportunities and challenges that could fundamentally alter risk management, audit processes, and governance frameworks within manufacturing organizations.

Existing research emphasizes blockchain's operational benefits, such as enhanced supply chain transparency (Zhang et al., 2023), but lacks empirical evidence on its implications for internal control

design and effectiveness. For example, decentralized consensus mechanisms may weaken governance hierarchies, conflicting with internal law emphasis on entity-level oversight (Chen & Liao, 2021). Furthermore, regulatory uncertainties and scalability limitations hinder blockchain adoption in manufacturing, as seen in emerging markets (Li et al., 2023). Without addressing these challenges, manufacturing firms risk systemic inefficiencies, cybersecurity vulnerabilities, and non-compliance with evolving regulations (Deloitte, 2021).

Notwithstanding the fact that the adoption of blockchain technology ensures transparency, security, and traceability in supply chain management, quality assurance, and smart contract automation in Nigeria, regulatory bodies are yet to establish standardized protocols for blockchain-enabled controls, leaving manufacturing firms to navigate ambiguities in governance and accountability (Israel et al., 2023).

Also, despite growing interest in blockchain applications, there is limited empirical research on how this technology impacts the design, implementation, and effectiveness of internal controls in the manufacturing sector. Key questions remain unanswered: How does blockchain's decentralized architecture influence accountability and segregation of duties? To what extent does its immutability enhance or complicate error detection and fraud prevention? What are the risks associated with integrating blockchain with legacy systems, and how do these risks affect the overall control environment? Furthermore, the dynamic nature of blockchain coupled with a lack of standardized protocols raises concerns about adaptability, scalability, and the need for updated internal control policies to address emerging vulnerabilities.

This study therefore seeks to investigate the effects of blockchain technology on the internal control systems of manufacturing firms, with a focus on identifying gaps in preparedness, evaluating shifts in control activities and assessing the implications for audit trails and compliance. By addressing these issues, the research aims to provide actionable insights for organizations navigating the integration of blockchain while maintaining robust internal controls. Failure to understand these dynamics could lead to systemic inefficiencies, exposure to cyber threats, or non-compliance with evolving regulatory requirements, ultimately undermining the strategic benefits of blockchain adoption in manufacturing. Thus, the study was geared towards achieving the following hypotheses:

H_{01}: Blockchain technology flexibility does not have significant effect on internal control system of manufacturing firms in Nigeria.

H_{02}: Blockchain technology adaptability does not have significant effect on internal control system of manufacturing firms in Nigeria.

H_{03}: Blockchain technology agility does not have significant effect on internal control system of manufacturing firms in Nigeria.

This study includes several sections. Therefore, the remainder of this study is structured as follows: Section 2 addresses the business rationale (an overview of the current state of the relevant literature). This is followed by Section 3, which deals with the methodology. Section 4 presents and discusses the results, while Section 5 deals with conclusion and recommendations.

2. Review of Related Literature

2.1. Blockchain Technology (BT)

International Business Machines (IBM) defines blockchain technology (BCT) as a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network, which can be tangible, or intangible to reduce risk and minimize costs. BCT provides immediate, shared, and completely transparent information to authorized networks that can track production, accounts, purchase orders, and payment status with end-to-end details of a transaction with efficiencies and opportunities (Hesham, Mohammed & Saurav, 2023).

According Iveline (2024), blockchain is the first native digital medium of exchanging values on a peer-to-peer basis. A blockchain protocol operates under certain rules, using globally distributed computations and strong encryption, which ensures the integrity of data transmitted between billions of devices without needing a trusted third party. Trust is "hard-coded" in the platform itself. That's why blockchain is called

the Trust Protocol. This technology acts simultaneously as a ledger of accounts, database, notary, sentry and clearing house and all of these are in consensus. Bajar, Kamat, Shanker and Barve (2022) opine that technology and IT systems and operational efficiency are the most significant factors of BCT. Since it can trace back the events that occurred in the network, the security of a blockchain is based on digital identities and cryptography. Therefore, BCT can contribute to key supply chain objectives. In technical terms, blockchain refers to a distributed ledger composed of a series of data blocks that are linked through cryptographic methods. Each block records a batch of network transaction information (Zachariadis, Hileman & Scott, 2019).

A blockchain is a digital ledger technology that operates in a decentralized and distributed manner, serving the purpose of recording and verifying transactions across multiple computers or nodes within a network. The core structure of a blockchain consists of a series of blocks, with each block containing a list of transactions (Vardia & Signh, 2022). Unlike traditional centralized systems, blockchain functions on a decentralized network of computers, meaning that no single entity or authority exercises complete control over the entire blockchain network. The ledger, which keeps a record of all transactions, is shared with all participating nodes in the network, ensuring transparency and security (Su et al., 2021).

2.1.1 Blockchain Technology Flexibility (BTF)

Blockchain technology flexibility is achieved by decoupling the business process's logic from its execution state, thus allowing run-time changes to the process execution without losing the fundamental properties of trust provided by the blockchain (Hesham, Mohammad & Saurav, 2023).

According to Sarah, Felix and Bernard (2021), blockchain technology enables the execution of collaborative business processes involving mutually untrusted parties. Existing tools allow such processes to be modeled using high-level notations and compiled into smart contracts that can be deployed on blockchain platforms. However, these tools do not provide mechanisms to cope with the flexibility requirements inherent to open and dynamic collaboration environments. In particular, existing tools adopt a static role binding approach wherein roles are bound to actors upfront when a process instance is created. Also, these tools do not allow participants to collectively make choices regarding alternative sub-processes or branches in the process model, at runtime.

2.1.2 Blockchain Technology Adaptability (BTAP)

In the study of Harrison (2024), he notes that blockchain technology has been proposed to achieve sustainable development through various solutions, such as carbon credit trading, energy systems and supply chain management. The study goes further to state that blockchain adaptability is the ability of blockchain technology to adapt to new uses and situations. Blockchain technology adaptability refers to the ability of a blockchain system to modify, upgrade, or reconfigure its architecture, protocols, or governance in response to changing technological, regulatory, or business needs without compromising security, decentralization, or performance (Okafor & Eme, 2022).

2.1.3 Blockchain Technology Agility (BTA)

Blockchain technology agility refers to the ability of a blockchain system to adapt, scale, and evolve in response to changing business, regulatory, or technical requirements while maintaining security, decentralization, and performance (Zhang et al., 2023). According to Gudgeon et al. (2020), blockchain technology agility refers to the ability of a blockchain system to adapt, scale, and evolve efficiently in response to changing requirements (e.g., regulatory, technical, or business needs) while maintaining its core principles of security, decentralization, and transparency. It emphasizes flexibility in design, governance, and functionality to meet dynamic real-world demands.

2.1.4 Internal Control System

COSO (2023) sees internal control as a process, effected by an entity's board of directors, management, and other personnel, designed to provide reasonable assurance regarding the achievement of objectives in the following categories:

- Effectiveness and efficiency of operations,
- Reliability of financial reporting,
- Compliance with applicable laws and regulations

Internal control comprises the plan of organization and all of the coordinate methods and measures adopted within a business to safeguard its assets, check the accuracy and reliability of its accounting data, promote operational efficiency, and encourage adherence to prescribed managerial policies (Elizabeth et al., 2023)

Internal control is a process, effected by an entity's board of directors, management, and other personnel, designed to provide reasonable assurance regarding the achievement of objectives relating to operations, reporting, and compliance (Amudo & Inanga, 2022). The study goes further to note that its a comprehensive strategy integrating financial, operational, and compliance controls to protect assets, mitigate risks, and ensure process efficiency. It aligns controls with strategic goals to enhance decision-making and transparency. International Standard on Auditing (ISA 400) defines internal control as all policies and procedure adopted by the management of an entity to assist in achieving the primary objectives of the management by ensuring that the business is conducted in the most efficient way possible and also ensuring strict adherence to management policies, safeguarding of asset, prevention and detection of fraud and timely preparation of reliable account records.

2.1.5 The Contributions of Blockchain Technology in Internal Control System of Manufacturing Firms in Nigeria

Blockchain technology is revolutionizing internal control systems in Nigerian firms by enhancing transparency, security, and efficiency. Below is an analysis of its key contributions, supported by academic and industry

1. Enhanced Data Integrity and Transparency

Blockchain's decentralized and immutable ledger ensures that financial and operational records cannot be altered fraudulently. This feature strengthens internal controls by reducing discrepancies and improving auditability (Nakamoto, 2008; Tapscott & Tapscott, 2016). In Nigeria, firms adopting blockchain for supply chain management have reported fewer cases of fraud due to real-time transaction verification (Omaliko et al., 2016; Eze et al., 2021).

2. Automation of Internal Controls via Smart Contracts

Smart contracts self-executing agreements on blockchain reduce human intervention in compliance processes. Nigerian firms using blockchain for payroll and procurement have minimized errors and fraud risks (Adesina & Ojo, 2020). For example, automated payment releases upon delivery confirmation improve accountability (Oyewole et al., 2022).

3. Improved Audit Efficiency

Blockchain enables continuous auditing, allowing real-time verification of transactions. Nigerian accounting firms report faster fraud detection (up to 33% improvement) when using blockchain-led audits (Okoye & Ademu, 2023). The technology also helps auditors trace discrepancies in tax filings (Adeleke, 2021).

4. Fraud Prevention and Risk Management

Blockchain's traceability helps firms detect fraudulent transactions early. A study of Nigerian banks found that blockchain reduced internal fraud by 40% due to tamper-proof transaction logs (Mordi & Omaliko, 2016; Okafor & Eme, 2022). Additionally, blockchain-based identity verification reduces payroll fraud (Nwankwo, 2023).

5. Regulatory Compliance and Tax Transparency

Blockchain improves tax compliance by providing verifiable transaction records. A study of Nigerian multinationals showed a 25% decline in tax evasion after blockchain adoption (Bello & Musa, 2023). However, regulatory uncertainty remains a challenge (SEC Nigeria, 2022).

2.2 Theoretical Framework

The theoretical framework which gives the meaning of a word in terms of the theories on blockchain technology and internal control system established in this study is Technology Acceptance Model Theory

2.2.1 Technological Acceptance Model Theory

Technology acceptance model was developed by Davis in 1989 from the Massachusetts Institute of Technology (MIT). The theory offers valuable intuitions on the efficiency and effectiveness of blockchain technology within the accounting field. TAM, a well-established theory, was initially crafted to predict and elucidate how individuals engage with or reject Information and Communication Technology (ICT). Rooted in the Theory of Reasoned Action (TRA), TAM centers on two pivotal factors influencing the adoption of technology: perceived usefulness and perceived ease of use. These factors now play a crucial role in comprehending how professionals perceive and employ blockchain technology in internal control system of a firm (Mordi & Omaliko, 2015).

Perceived usefulness, in the context of blockchain technology, refers to an individual's belief in how much blockchain can enhance accounting practices. Blockchain's transparent and immutable ledger capabilities hold the potential to transform traditional accounting by improving efficiency and transparency. On the other hand, perceived ease of use concerns how effortlessly individuals believe they can integrate blockchain technology into business and business-related areas.

Blockchain technology has brought about substantial changes in accounting practices and financial management. Particularly in internal control system, the widespread adoption and effective utilization of blockchain are essential to uphold the integrity of financial records. Institutional efforts are instrumental in promoting blockchain adoption, but the willingness and active engagement of individuals within accounting organizations are equally crucial for its success and institutionalization.

To gain a comprehensive understanding of how blockchain technology are perceived and embraced in manufacturing firms in Nigeria, various theoretical models, including TAM, have been employed. TAM, building upon the Theory of Reasoned Action, posits that an individual's intention to use technology primarily hinges on their perception of its usefulness and ease of use. In the context of blockchain adoption, this implies that business owners are more inclined to embrace blockchain technology if they view it as beneficial for their business and find it user-friendly (Fitriyani, Sfenrianto, Wang & Susanto, 2016; Omaliko et al., 2021).

Thus, the study was anchored on Technological Acceptance Model Theory. The justification for using this theory to underpin the study stems from the fact that literature review has demonstrated the existence of relationship between technological usefulness, acceptance, fraudulent practices and internal control system in manufacturing firms.

2.3 Empirical Review

Harrison (2024) examined the relationship between the adoption of blockchain technology and environmental efficiency using a sample of U.S. firms over the 2015-2019 period. The results of their study using regression model showed that the adoption of blockchain technology is positively and significantly associated with environmental efficiency, suggesting that the use of blockchain improves environmental sustainability. In further analyses, the study found that the relationship between blockchain and environmental efficiency is more pronounced for firms in the financial and technological industries.

Owa et al. (2024) investigated the effectiveness of integrating blockchain accounting systems as a means to mitigate tax evasion within Nigerian multinational corporations (MNCs). Drawing on a survey design methodology involving 300 respondents from 10 Nigerian MNCs, the study examined the relationship between blockchain integration and tax evasion reduction, as well as the challenges associated with blockchain adoption in this context. Simple regression analysis was used to evaluate the null hypothesis at a 0.05 significance level. The study adopted the diffusion of innovation theory to better understand how innovations are adopted and implemented within organizations. Findings revealed a significant positive correlation between blockchain integration and tax evasion mitigation, highlighting the potential of blockchain technology to enhance transparency and accountability in financial transactions. However, challenges such as regulatory uncertainties, technological barriers, and organizational resistance hinder widespread blockchain adoption within Nigerian MNCs.

Akinadewo et al. (2023) investigated the influence of disruptive technology on the effectiveness of accounting practice in Nigeria. This research employed a survey research approach and distributed a structured questionnaire among professional bodies in the Southwestern states of Nigeria. Ordinary Least Squares and correlation analysis were used to analyse data. The results unveiled substantial positive impact between the independent variables through the proxies and the effectiveness of accounting practices in Nigeria.

Zhang et al. (2023) investigated the impact of applying blockchain technology on real earnings management is empirically investigated by OLS multiple regression model with a sample of A-share listed companies in Shanghai and Shenzhen from 2012 to 2022. The results show that the application of blockchain technology by listed companies can significantly inhibit their real earnings management, and the proportion of institutional investors shareholding and the proportion of independent directors have a positive adjusting effect on this inhibition. In addition to this, other factors also have an impact on the relationship between blockchain and true earnings management, so further research finds that the implementation of blockchain technology by non-state owned enterprises is more effective in suppressing their real earnings management than state-owned enterprises; the implementation of blockchain technology by listed companies has a stronger suppression effect on the level of real earnings management in cities with a higher level of Internet development; and digital transformation strengthens the suppression effect of blockchain technology on real earnings management.

Poonam et al. (2023) examined the relationship between blockchain capabilities (BCC), competitive advantages (CA) and organizational performance (OP). the study further evaluated the mediating role of CA on the relationship between BCC and OP. In this context, scientific research model consisting of a hypothesis has been developed from the existing literature. The proposed model was tested using statistical data collected from Blockchain specialists, blockchain product marketing managers, experts of future and emergent technology and VP/AVP/Chief Manager/Branch head of banks/ financial Analyst/divisional Managers who are involved in planning and deployment of practical blockchain in banking/financial sector. Data was analyzed and tested through AMOS 22.0 and process macro using a sample of 289 responses. The empirical result using OLS indicated that there is a significant positive relationship between BCC, CA and OP.

Ahmed et al. (2023) demonstrate the impact of the use of blockchain technology on the financial performance of investment projects developed by the Ministry of Sports. We used the descriptive approach (survey study method) as an appropriate method to achieve the objectives of the study due to the suitability of its procedures. The participants in the study included some leaders of the Ministry of Sports and experts in the field of sports investment, as well as some leaders working in the directorates of youth and sports, and some members of the board of directors of the Olympic Committee, sports federations, sports clubs, and youth centers. The study sample was selected in a deliberate way based on the categories of the study population. There were 300 participants in the study, and the researchers used two questionnaires as tools to collect the data. The results revealed a lack of the use of blockchain technology at the Ministry of Sports and a low level of financial performance at the Ministry of Sports. With a correlation between the level of financial performance and the use of blockchain technology, the level of the financial performance of the investment projects developed by the Ministry of Sports could be predicted based on the use of blockchain technology.

Similarly, Igbekoyi et al. (2023) evaluated the consequences of big data on the efficiency of accounting practices in Nigeria. Survey research design, through structured questionnaire was used as the primary data collection tool. Population was all the 35 registered accounting firms in Lagos State. The sample size was determined through a census sampling technique, which included 100% of the population. Given the manageable population size, six respondents were selected from each accounting firm, resulting in a total of 210 respondents. Of this sample, 197 responses were returned, representing an impressive 94% response rate. Descriptive statistics and ordinary least squares (OLS) regression analysis techniques used for the analysis of data. Results revealed the significant influence of the proxies of the independent variable on the efficiency of accounting practices in Nigeria.

Israel et al. (2023) assessed the impact of blockchain technology on the effectiveness of accounting practices in Nigeria. This study used a qualitative approach and the study's primary data came from the distribution of a structured questionnaire to the targeted respondents, which comprised accountants, finance analysts, and blockchain experts. The total population was 178 registered accounting firms in Nigeria as of 31st December 2022. A purposive sampling technique was used to select 123 firms from which 3 questionnaires were distributed to each of the firms selected, totaling 369, which served as the sample size. Data were analyzed through descriptive statistics and inferential statistics. The overall results found that blockchain technology had a significant positive effect on the efficacy of accounting practice in Nigeria. Thus, this study recommends that accounting firms in Nigeria should consider investing in blockchain technology to improve data security, transparency, and efficiency.

3. METHODOLOGY

The study adopted a survey design in order to examine the effect of blockchain technology on internal control system of manufacturing firms in Nigeria using some selected manufacturing firms in Anambra state as a reference point. It is a design that incorporates personal interview, observation, and questionnaire to ensure corroboration of facts, thus ensuring the validity and reliability of the data collected. The selected manufacturing firms in Anambra State ranges from Alben Pharmaceutical Industries Ltd Ogidi, KP Pharmaceutical Industries Ltd Ogidi, Juhel Pharmaceutical Industries Ltd Awka to Millennium Industries Ltd Awka. Data for the study was collected through the use of questionnaire survey administered to the respondents out of which 55 responses were received and were used in the data analysis. The questionnaire survey was designed where respondents were asked to assess the effect of blockchain technology on internal control system in Nigeria using Likert five point scales referred as: (1) To a Very High Extent (THE), (2) To a High Extent (HE), (3) Neutral (N), (4) To a Very Low Extent (TLE) and (5) To a Low Extent (LE).

The collected data was transformed to scale measurement using Likert five point scale and the hypotheses were statistically tested using Least Squares Regression Model with the aid of E-Views 12.

3.1 Model Specification

In line with the previous studies, the present study adapted and modified the model of Rehab et al. (2023) in examining the effect of blockchain technology on internal control system of manufacturing firms in Nigeria. This is shown below as thus;

Rehab et al. (2023): $\mathbf{AQ = B_0 + B_1\ X1 + B_2\ X2 + B_3\ X3 + e}$

The functional model for the study is shown below as thus:

$\mathbf{ICS = F\ (BTF, BTAP, BTA)}$

The explicit form of regression designed for the study is shown in equation below as thus:

$\mathbf{ICS = \beta_0 + \beta_1 BTF + \beta_2 BTAP + \beta_3 BTA + \varepsilon}$

Where:

ICS = Internal Control System

BTF = Blockchain Technology Flexibility

BTAP = Blockchain Technology Adaptability

BTA = Blockchain Technology Agility

μ = Stochastic Term

$\beta_1 - \beta_3$ = Coefficient of Regression Equation

β_0 = Constant coefficient (intercept) of the model

'*A Priori*' is given as: $\beta_0, \beta_1, \beta_2, \beta_3 > 0$

Decision Rule: accept Ho if P-value >1-5% significant level otherwise reject Ho

4. DATA ANALYSIS AND RESULTS

4.1 Distribution of Respondents Responses

The distribution of the respondents responses was exposited on table 1 below as thus:

Table 4.1.1: Analysis of the Respondents Responses

	Item	Questionnaire Distributed	Questionnaire Retrieved	Percentage
	Manufacturing Firms			
1	Alben Pharmaceutical Industries Ltd Ogidi	19	18	33
2	KP Pharmaceutical Industries Ltd Ogidi	13	11	20
3	Juhel Pharmaceutical Industries Ltd Awka	15	14	25
4	Millennium Industries Ltd Awka	14	12	22
	Total	**61**	**55**	**100.00**

Source: Field Survey (2025)

Table 4.1.1 above shows that 61 copies of questionnaire were distributed to the four (4) selected manufacturing firms in Anambra State out of which only 55 copies representing 90.2% were retrieved. Thus, the retrieved copies were used in the data analysis. This is further exposited below as thus;18 respondents representing 33% of the respondents were the staff of Alben Pharmaceutical Industries Ltd Ogidi; 11 respondents representing 20% of the respondents were the staff of KP Pharmaceutical Industries Ltd Ogidi, 14 respondents representing 25% of the respondents were the staff of Juhel Pharmaceutical Industries Ltd Awka while the remaining 12 respondents representing 22% of the respondents were the staff of Millennium Industries Ltd Awka.

4.2: Descriptive Summary

The descriptive summary is a set of methods used to summarize and describe the main features of a dataset such as its central tendency, variability and distribution. Thus provides an overview of the data and help identify patterns and relationships between variables. This is shown on table 4.2.1 as thus:

Table 4.2.1: Descriptive Statistics

	ICS	BTF	BTAP	BTA
Mean	4.520000	4.550000	4.340000	4.670000
Median	4.500000	4.500000	4.400000	4.420000
Maximum	4.700000	4.650000	4.600000	4.800000
Minimum	4.400000	4.200000	3.900000	4.120000
Std. Dev.	0.109545	0.130384	0.296648	0.240985
Skewness	0.867528	0.363173	-0.562764	0.892732
Kurtosis	2.729167	1.628028	1.897340	1.787634
Jarque-Bera	0.642452	0.502060	0.517224	0.567376
Probability	0.725259	0.777999	0.772123	0.898763
Sum	22.60000	21.30000	21.70000	24.09853
Sum Sq. Dev.	0.048000	0.063000	0.352000	0.686000
Observations	5	5	5	5

Source: E-View 12 Computational Results (2025)

From Table 4.2.1 above, the mean (average), maximum values, minimum values, standard deviation and Jarque-Bera Statistics (Normality Test) were shown. First, it can be observed that internal control system (ICS) was characterized by a positive value of 4.52. This implies that blockchain technology enables effective internal control system among the sampled firms. Thus, blockchain technology ensures effective internal control system in Nigeria. The distribution is platykurtic since the kurtosis (2.73) is less than 3, implying that the outliers are few. The Jarque-Bera probability of 0.73 is greater than 0.05, which means that the distribution of internal control system comes from a normal distribution. The average value of blockchain technology flexibility (BTF) for the sampled firms was 4.55 with a standard deviation value

of 0.13. This means that blockchain technology flexibility ensures effective internal control system. The maximum value of BTF was 4.65 and the minimum value of BTF was 4.20 reflects a narrow range suggesting that the sampled manufacturing firms have blockchain technological flexibility. The distribution for the study is platykurtic since the kurtosis (1.62) is less than 3, implying that the outliers are few. The Jarque-Bera probability of 0.78 is greater than 0.05, which means that the distribution of blockchain technology flexibility is not different from a normal distribution.

Also, the mean value of blockchain technology adaptability (BTAP) for the sampled firms was 4.34 with a standard deviation value of 0.29. This means that blockchain technology adaptability enables effective internal control system in manufacturing firms in Nigeria. The maximum value of BTAP was 4.60 indicating a high variation in blockchain technology adaptability among the sampled manufacturing firms in Nigeria while the minimum value of BTAP was 3.90 also indicate a significant variation in blockchain technology adaptability among the sampled manufacturing firms in Nigeria. The distribution of BTAP for the study is platykurtic since the kurtosis (1.89) is less than 3, implying that the outliers are few. The Jarque-Bera probability of 0.77 is greater than 0.05, which means that the distribution of blockchain technology adaptability comes from a normal distribution.

The mean value of blockchain technology agility (BTA) for the sampled firms was 4.67 with a standard deviation value of 0.24. This means that blockchain technology agility ensures effective internal control system. The maximum value of BTA was 4.80 and the minimum value of BTA was 4.12 reflects a narrow range suggesting that the sampled manufacturing firms have blockchain technology agility. The distribution for the study is platykurtic since the kurtosis (1.79) is less than 3, implying that the outliers are few. The Jarque-Bera probability of 0.89 is greater than 0.05, which means that the distribution of blockchain technology agility is not different from a normal distribution.

Table 4.2.2: Correlation Matrix

	ICS	BTF	BTAP	BTA
ICS	1.0000			
BTF	0.2910	1.0000		
BTAP	0.4139	-0.8608	1.0000	
BTA	0.3031	0.7927	0.6763	1.0000

Source: Author's Computation

Key: ICS – Internal Control System; BTF – Blockchain Technology Flexibility; BTAP - Blockchain Technology Adaptability; BTA - Blockchain Technology Agility

Table 4.2.2 above shows the relationship between all pairs of independent variables and dependent variables used in the regression model. It reveals that all the independent variables have positive correlation with the dependent variable (ICS) while one of the components of blockchain technology (BTF) has negative relationship with (BTAP). The values on the diagonal are all 1.0000 which shows that each variable is perfectly correlated with itself.

In checking for multi-collinearity, we noticed that no two explanatory variables were perfectly correlated. This means that there is an absence of multi-collinearity in our models. Multi-collinearity between the explanatory variables may result to wrong signs or implausible magnitudes in the estimated model coefficients and the bias of the standard errors of the coefficients.

4.3: Test of Hypotheses

Least Squares was developed to test the linear relationship between the dependent and independent variables. It was operated using E-Views 12 as shown in the table 4.3.1 below:

Table 4.3.1: Result on the Effect of Blockchain Technology on Internal Control System of Manufacturing Firms in Nigeria

Dependent Variable: ICS
Method: Least Squares
Date: 04/1/25 Time: 5:12
Sample: 1-5
Included observations: 5

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BTF	0.167362	0.037653	4.444852	0.0004
BTAP	0.408994	0.105913	3.861603	0.0029
BTA	0.336601	0.045133	7.457979	0.0000
C	8.366768	1.464375	5.713542	0.0000
R-squared	0.906631	Mean dependent var		4.520000
Adjusted R-squared	0.813262	S.D. dependent var		3.015098
S.E. of regression	0.047338	Akaike info criterion		10.00698
Sum squared resid	0.004482	Schwarz criterion		9.050753
Log likelihood	10.44828	Hannan-Quinn criter.		9.024624
F-statistic	9.710204	Durbin-Watson stat		2.000972
Prob(F-statistic)	0.000958			

Source: Author's Computation (2025)

4.4: DISCUSSION OF FINDINGS

The coefficient of determination R^2 shows 0.91 indicating that the overall model explained 91 percent of the total variations in the dependent variable (internal control system). Thus shows that these variables (BTF, BTAP, BTA) can only explain 91 percent of change in internal control system in Nigeria leaving 9 percent unexplained. This is to say that there are other factors that can contribute to effective internal control system in manufacturing firms Nigeria other than the use of blockchain technology. The sig. (or p-value) is .0001 which is below the .01 level; hence, we conclude that the overall model is statistically significant, or that the variables have a significant and joint effect on the dependent variable. With this, the researcher affirms the validity of the regression model adopted in this study.

The results of the regression are therefore slated below as follows:

H_{01}: Blockchain technology flexibility does not have significant effect on internal control system of manufacturing firms in Nigeria.

This hypothesis was tested and the result of this regression as exposited on table 4.3.1 indicates that the relationship between BTF and ICS is positive and significant. This is justified with the P-value (significance) of 0.0004 which is less than the 1% level of significance adopted. Likewise the result of positive coefficient of 0.167 indicates that blockchain technology is a determinant of effective internal control system in Nigeria. We consequently rejected null hypothesis and accepted the alternate hypotheses which contends that blockchain technology flexibility have significant effect on internal control system of manufacturing firms in Nigeria. This is in tandem with the finding of Mladen (2023), Hesham et al. (2023), Israel et al. (2023) who found that the blockchain technology have positive effect on supply management performance of firms.

H_{02}: Blockchain technology adaptability does not have significant effect on internal control system of manufacturing firms in Nigeria.

This hypothesis was tested and the result of this regression as exposited on table 4.3.1 indicates that the relationship between BTAP and ICS is positive and significant. This is justified with the P-value

(significance) of 0.0029 which is less than the 1% level of significance adopted. Likewise the result of positive coefficient of 0.409 indicates that blockchain technology adaptability ensures effective internal control system in Nigeria. We consequently rejected null hypothesis and accepted the alternate hypotheses which contends that blockchain technology adaptability has significant effect on internal control system of manufacturing firms in Nigeria. This is in agreement with the priori expectations of Igbekoyi et al. (2023), Sobhi et al. (2023), Poonam et al. (2023) who reported that blockchain technology influence firm performance in a controlled environment.

H_{03}: Blockchain technology agility does not have significant effect on internal control system of manufacturing firms in Nigeria.

This hypothesis was tested and the result of this regression as exposited on table 4.3.1 indicates that the relationship between BTA and ICS is positive and significant. This is justified with the P-value (significance) of 0.0000 which is less than the 1% level of significance adopted. Likewise the result of positive coefficient of 0.337 indicates that blockchain technology agility is a determinant of effective internal control system in Nigeria. We consequently rejected null hypothesis and accepted the alternate hypotheses which contends that blockchain technology agility has significant effect on internal control system of manufacturing firms in Nigeria. This is in consonance with the priori expectations of Zhang et al. (2023), Harrison (2024), Owa et al. (2024) who found that blockchain technology ensures environmental efficiency and effective accounting system.

5. CONCLUSION

The study examined the effect of blockchain technology on internal control system, of manufacturing firms in Nigeria. In assessing this, the study employed a survey research design, and data collected through the use of questionnaire administered to the staff of the accounting and auditing section of the selected manufacturing firms in Anambra State. The results from the inferential analysis revealed that blockchain technology ensures effective internal control system in manufacturing firms in Nigeria. Thus, the study concludes that blockchain technology enables effective internal control system in manufacturing firms in Nigeria.

5.1 RECOMMENDATION

In lieu of the findings of the study, the following recommendations were made:

1. The study recommends that manufacturing firms in Nigeria should consider investing in blockchain technology, its flexibility enables effective internal control system which improve data security, transparency, and efficiency.
2. Successful blockchain technology adaptability in manufacturing firms requires collaboration between different departments within the organization, as well as external stakeholders such as regulators and technology partners. Manufacturing firms should therefore establish a cross-functional teams to drive the blockchain initiative, ensuring that all relevant stakeholders are engaged in the process.
3. For manufacturing firms to maximize the full potentials of blockchain technology, they must define clear objectives for their blockchain implementation, identifying specific pain points that the blockchain can address. These objectives should be aligned with the organization's control system and overall strategic goals. Thus, will ensure that the blockchain solution delivers tangible benefits.

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Appendix 1

QUESTIONNAIRE

SECTION A: Personal Data of Respondent

Sex: Male [ ] Female [ ]

Manufacturing Firm: Alben Pharmaceutical Industries Ltd Ogidi [ ], KP Pharmaceutical Industries Ltd Ogidi [ ], Juhel Pharmaceutical Industries Ltd Awka [ ], Millennium Industries Ltd Awka [ ]

SECTION B: Questionnaire Items

Instruction: Kindly read through all the item statements carefully and indicate your response against each statement by ticking [√] in the appropriate column using the following response:

To a Very High Extent (TVHE)
To a High Extent (THE)
Neutral (N)
To a Low Extent (TLE)
To a Very Low Extent (TVLE)

CLUSTER I: Internal Control System (Dependent Variable)

S/N	STATEMENTS	TVHE	THE	N	TLE	TVLE
1	How does blockchain technology's immutability strengthen data integrity within the internal control systems of Nigerian manufacturing firms?					
2	To what extent does blockchain-based smart contracts streamline transaction verification processes in internal control mechanisms?					
3	To what extent does blockchain adoption reduce fraud risks in inventory management and procurement processes of Nigerian manufacturing firms?					
4	How does blockchain integration enhance compliance with Nigerian financial regulations (e.g., IFRS, SEC requirements) in internal auditing and reporting?					
5	Does blockchain implementation ensure cost-effectiveness of internal control systems in Nigerian manufacturing firms?					

CLUSTER II: Blockchain Technology Flexibility

S/N	STATEMENTS	TVHE	THE	N	TLE	TVLE
1	How does blockchain’s ability to customize smart contracts enhance transactional transparency in Nigerian manufacturing firms?					
2	To what extent does blockchain’s modular architecture improve scalability in inventory management processes?					
3	Does blockchain’s interoperability with legacy systems play in reducing operational redundancies?					
4	How does blockchain’s decentralized framework mitigate risks of data manipulation in financial reporting?					
5	Does blockchain’s adaptability to regulatory changes strengthen compliance monitoring in Nigerian manufacturing firms?					

CLUSTER III: Blockchain Technology Adaptability

S/N	STATEMENTS	TVHE	THE	N	TLE	TVLE
1	How does blockchain's capacity to integrate with IoT devices streamline real-time asset tracking in supply chains?					
2	To what extent does blockchain's scalability relate to error reduction in procurement processes?					
3	To what extent does blockchain's automated audit trails enhance accountability in cost management?					
4	How does blockchain's adaptability to multi-stakeholder collaboration reduce fraud risks in vendor transactions?					
5	What effect does blockchain's real-time data synchronization have on mitigating inventory discrepancies?					

CLUSTER IV: Blockchain Technology Agility

S/N	STATEMENTS	TVHE	THE	N	TLE	TVLE
1	How does blockchain's rapid response to transactional anomalies improve fraud detection capabilities?					
2	To what extent does blockchain's ability to process high-frequency transactions optimize cash flow management?					
3	Does blockchain's decentralized consensus mechanisms have impact on reducing delays in audit processes?					
4	How does blockchain's agility in updating records strengthen traceability in production quality control?					
5	Does blockchain's real-time data-sharing capability improve decision-making speed in risk management?					

Appendix 2

Analysis of Respondents Responses

Distribution of Internal Control System (Dependent Variable)

	5	4	3	2	1			
QUESTIONS	TVHE	THE	N	TVLE	TLE	TOTAL	WEIGHTED SUM	LIKERT
1	44	3	5	2	1	55	252	4.58
2	40	6	0	9	0	55	242	4.40
3	41	4	3	5	2	55	242	4.40
4	43	5	2	3	2	55	249	4.53
5	45	2	0	7	1	55	258	4.70

Distribution of BTF (Blockchain Technology Flexibility)

	5	4	3	2	1			
QUESTIONS	TVHE	THE	N	TVLE	TLE	TOTAL	WEIGHTED SUM	LIKERT
1	44	6	3	2	0	55	256	4.65
2	35	8	2	5	5	55	231	4.20
3	34	11	4	4	2	55	236	4.29
4	36	9	1	9	0	55	237	4.31
5	46	3	0	6	0	55	254	4.62

Distribution of BTAP (Blockchain Technology Adaptability)

	5	4	3	2	1			
QUESTIONS	**TVHE**	**THE**	**N**	**TVLE**	**TLE**	**TOTAL**	**WEIGHTED SUM**	**LIKERT**
1	26	17	2	5	5	55	215	3.90
2	38	5	2	5	5	55	231	4.20
3	43	6	1	4	1	55	251	4.56
4	40	5	3	7	0	55	235	4.27
5	43	7	1	2	2	55	252	4.60

Distribution of BTA (Blockchain Technology Agility)

	5	4	3	2	1			
QUESTIONS	**TVHE**	**THE**	**N**	**TVLE**	**TLE**	**TOTAL**	**WEIGHTED SUM**	**LIKERT**
1	39	6	4	2	4	55	264	4.80
2	36	4	8	2	5	55	229	4.16
3	31	10	4	4	6	55	227	4.12
4	38	3	5	2	6	55	227	4.13
5	40	5	3	7	0	55	235	4.27