A Transparent and Traceable Budget Process in Nigeria Using Blockchain Technology

Rabi Muhammad Enagi
Department of Computer Science, Federal university of Technology Minna, Nigeria.
Mobile +23408131507001, Email Address rabeeybeema@gmail.com

Dr. Oluwaseun Adeniyi Ojerinde
Department of Computer Science, Federal university of Techno logy Minna, Nigeria
Mobile +2348022226995, Email Address O.ojerinde@futminna.edu.ng
&
Dr. Solomon Adelowo Adepoju
Department of Computer Science, Federal university of Technology Minna, Nigeria
Mobile +2348035829748, Email Address solo.adepoju@futminna.edu.ng

Abstract
The Nigerian economy is beset by a slew of imbalances in the formulation and implementation of economic policies. Most problems in Nigeria are caused by imbalances in budget formulation and implementation. Budget padding and budget mismanagement are the primary modes through which corruption is carried out in Nigeria. In the 2019 Open Budget Index (OBI), Nigeria ranked 97th out of 117 countries, with a transparency score of 21 out of 100. This study employed a qualitative research method, using three approaches: a literature review, secondary research and case studies, to generate research evidence. Qualitative data collection and analysis were undertaken using a literature study to discover Blockchain Technology's benefits and examine the underlying challenges and causes of corruption in the budget process. The results of this study identify government non-trnsparency and lack of traceability as the primary causes of long-term budget failures. A consensus-driven collaborative National budget framework based on blockchain is recommended to establish communication between government departments. Blockchain technology can help combat budget-related corruption and the technology can be used as a budget-tracking system. Nigerians will be able to track budgets in this manner, which will aid in the elimination of corruption and embezzlement of funds because transaction data such as transaction amount, time, account numbers, and receivers will all be made public. The blockchain promises tamper-proof records that corrupt bureaucrats will be unable to alter. When corruption represents a breach of trust, a technology that builds trust becomes an appealing solution.

Key words: *Budgeting, Budget process, Blockchain Technology, Nigeria.*

1.1 Introduction

The Nigerian economy is beset by a slew of imbalances in the formulation and implementation of economic policies. Most problems in Nigeria are caused by imbalances in budget formulation and implementation. Budgeting is an integral part of the government, which is the nerve center of governance at all levels. This is particularly because of its central role in the determination of government revenue and expenditure (Ejumudo & Ejumudo, 2021). Budgeting can be viewed as a process of taking deliberate steps to move the relevant economic system from its current state to the desired state (Shimawua, 2020).

The budget is a critical policy document that prioritizes the government's annual and multi-year goals. Aside from financing new and existing programs, the budget is the primary tool for implementing fiscal policy and thus influencing the overall economy (Idris et al., 2021). The annual budget is the legal mechanism for acquiring, allocating, and distributing national resources for the nation's socioeconomic development (Ngara & Dasat, 2020). Budgeting is thus central to implementing government policy and realizing its numerous programs, projects, operations, and activities (Ejumudo & Ejumudo, 2021). The significance and vital function that budgeting is expected to play in the development of all nations explains why a growing number of researchers and professionals have given increasing attention to the academic debate on the relevant problem. (Ejumudo & Ejumudo, 2021).

Government budgetary corruption is a severe problem in Nigeria, and it is a strategy used by politicians and government workers to divert public funds (Olarewaju et al., 2021). Nigeria's budgetary processes have been left to the whims and caprices of bureaucrats and politicians. Thus, extra-budget spending, large government deficits financed largely by monetary growth, large recurrent spending and debt service costs, poorly conceived projects and programs, poor linkage between spending and development priorities, poor accountability and transparency, low level of capital budget implementation, and reliance on largely manual and outdated procedures have all plagued Nigerian public budgets (Olu-adeyemi & Okajare, 2020). Many modern governments have adopted ICT and e-transparency tools to create more inclusive regimes in a variety of areas, including budgeting. While the federal government is mired in bureaucracy and slow-moving processes, blockchains have the potential to significantly increase the federal government's efficiency and speed (Bedin et al., 2020).

Following the 2008 Global Financial Crisis, the term "blockchain" exploded onto the international stage (Boiardi & Stout, 2021). Blockchain technology has the potential to transform interactions between governments, businesses, and citizens in ways that were unimaginable a decade ago. Though it is frequently associated with technologies such as artificial intelligence (AI) or the Internet of Things (IoT), the technology is distinct in its fundamental nature. Unlike other technologies, which have the potential to provide entirely new services to citizens and other stakeholders, blockchain has the potential to revamp existing processes in order to unlock new sources of efficiency and value (NITI, 2020). Blockchain technology is a distributed ledger technology that can be used to share decentralized and transactional data across a large network of untrusted entities. This technology enables a new type of distributed software architecture capable of achieving consensus on shared states without the need for trust with any central entity/participant (MeitY, 2021).

Blockchain technology has the potential to play a critical role in preventing government corruption and increasing public transparency. Its technology is distinctive in that it combines permanent and tamper-proof record keeping with real-time transaction transparency and automated smart contract functionality (Tong, 2021). Blockchain enables network participants to interact and communicate with one another without the need for a significant third party to manage and provide verification services. Communication between network nodes is validated before being saved as a transaction in a Blockchain database. In Blockchain, various cryptography primitives, such as digital signatures, are used to determine the level of trust for broadcasting transactions between nodes (Hameed et al., 2021).

The data structure used in Blockchain Technology aids in the preservation of an unchangeable record of transactions in a chronological order. As a result, Blockchain Technology improves transparency, immutability, and efficiency, making it unique. (MeitY, 2021). Blockchain systems use the consensus idea to assure the trustworthiness of data and transactions and to preserve trust across decentralized

nodes. Nodes do not accept any trusted third party's services to govern their behavior and interactions (Hameed et al., 2021).

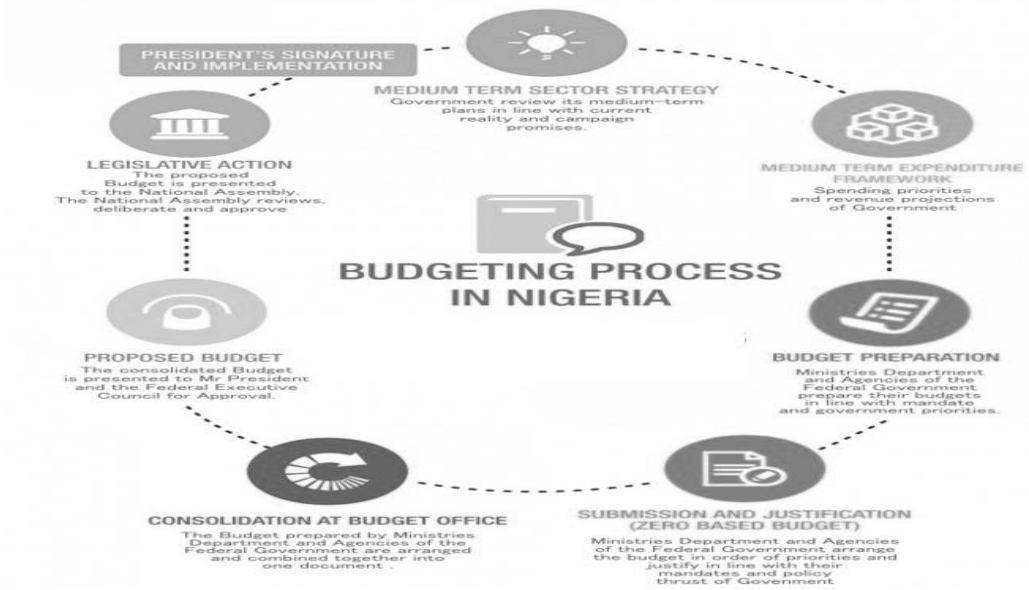
Blockchain technology, as a distributed ledger, has the potential to reduce bureaucracy, improve administrative process efficiency, and boost trust in public record keeping (Piya Yuenyongsuwan, 2021). As a result, as Moura, Brauner, and Janissek-Muniz (2020) point out, the fact that blockchain can provide secure data storage and management helps to make the case for its use in government budget processes.

2.0 Literature Review

2.1 Budget Process in Nigeria

The process by which governments initiate, consider, and approve budget proposals are referred to as the budget process. It entails an institutionally and legally ordered series of interconnected activities such as preparation, submission, authorization, execution, audit, and review (Ngara & Dasat, 2020). The President is legally responsible for budget preparation under Section 81(1) of the 1999 Constitution of the Federal Republic of Nigeria (CFRN), as amended. Traditionally, the President delegated this function to the Ministry of Finance (Effiom, 2019). The 1999 Constitution (as amended) established the executive and legislature as the primary actors in Nigeria's budget process. Sections 4, 59, 80-81 of the 1999 Federal Republic of Nigeria Constitution, as amended, specifically detailed the powers and responsibilities of the two arms of government regarding how monies accruing to the country may be expended over time (Ngara & Dasat, 2020). The establishment of the Budget Office of the Federation (BOF) and the Federal Ministry of Budget and National Planning (FMBNP) signaled a shift away from the traditional practice of centralizing federal budget-related matters in the Federal Ministry of Finance (FMF). Thus, in Nigeria, the responsibility for preparing the national budget is now a function of multi-agency collaboration, facilitated primarily by the FMBNP, BOF, and FMF (Effiom, 2019). Figure 1 depicts how the federal government budget is prepared.

Figure 1: The Federal Government Budget Process



(BudgIT, 2016)

2.2 Challenges Facing the Nigeria Budget Process

The budget process in Nigeria is not without its huge challenges.

- **Budget Padding:** The constitution empowers the executive to initiate and prepare the budget estimate and present it to the legislature for scrutiny and approval before funds can be withdrawn from the consolidated revenue fund, but the arms have always been involved in attempts to outwit each other (Chiamogu et al., 2019). According to (Mark, 2019), Padding a budget means increasing a project's expenses or decreasing its expected revenue to make the budget proposal larger than the actual estimates for the Budget. Padding a budget establishes a precedent that allows those involved to corner public funds by advancing the excess of project costs to themselves or their cronies.
- **Inaccurate Data:** Data is critical for budgeting, but it is frequently unreliable or unavailable. The budgeting process has always been reduced to hunches and guesswork due to a lack of reliable qualitative and quantitative data (Ngara & Dasat, 2020). Cyberattacks on an organization's data are frequently the result of data residing on a centralized database. Furthermore, these centralized solutions do not provide adequate transparency (Geroni, 2021).
- **Poor accountability and transparency:** lack of transparency and accountability is at the top of the list of challenges confronting Nigeria's public budgetary process. This occurs frequently throughout the budgetary process (Olu-adeyemi & Okajare, 2020)
- **Late presentation of the appropriation Bill:** The executive's late presentation of the appropriation Bill to the National Assembly, strained executive-legislative relationship, which causes unnecessary delays in the passage of Appropriation Bills, corruption, and a lack of political will by legislators (Ngara & Dasat, 2020)
- **Delay in budget processes:** Budget preparation, submission, consideration, approval and signing delays are prevalent in the Nigeria’s budget process to an extent that the budget is often not available for implementation in the first quarter and a better part of the second quarter over the past one and half decades (Idris et al., 2021).

2.3 Blockchain

Blockchain is an innovative distributed ledger technology that Satoshi Nakamoto first used in the design and development of Bitcoin in 2009. Blockchain is a conglomeration of various inventions with a clear commercial value (MeitY, 2021). A blockchain is a distributed append-only data structure that stores data in blocks that are linked using cryptography (Avarikioti, 2021)

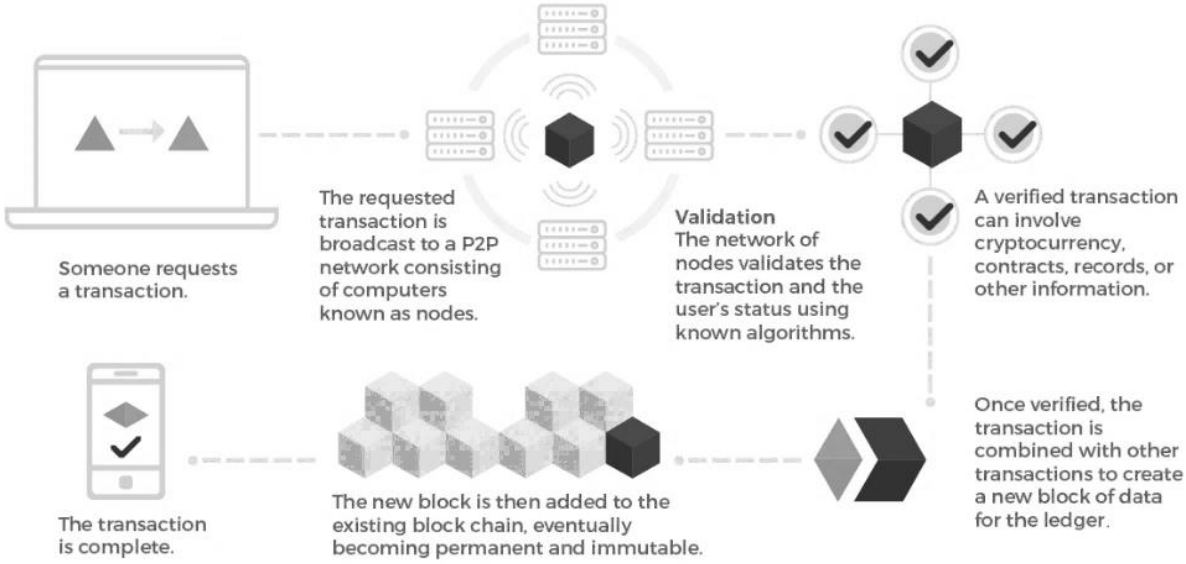
2.4 Blockchain Process

Transactions are secured by an encryption code and composed of the receiver, the transaction information, and the sender.

- **Transaction definition:** It is the initial step in which the transaction is created by a sender who has the receiver's public address information and a cryptographic digital signature that verifies the transaction's credibility and validity.
- **Transaction authentication:** The message is held temporarily until the nodes validate the transaction used to create a block, with nodes performing message validation cryptographically by decrypting the digital signature.
- **Block Creation**: one of the network nodes uses pending transactions to update the block or ledger, and this updated block is shown to nodes waiting for validation at a specific time interval.

- **Block validation:** When a node in the network receives a request for updated block validation, it goes through a repetitive process in which nodes seek the agreement of other nodes in the network to verify the block.
- **Block chaining:** When all transactions in the block are approved, a new block is attached to the current block and the latest state of the block is shown to the remaining blocks in the network.

Figure 2: Blockchain Process

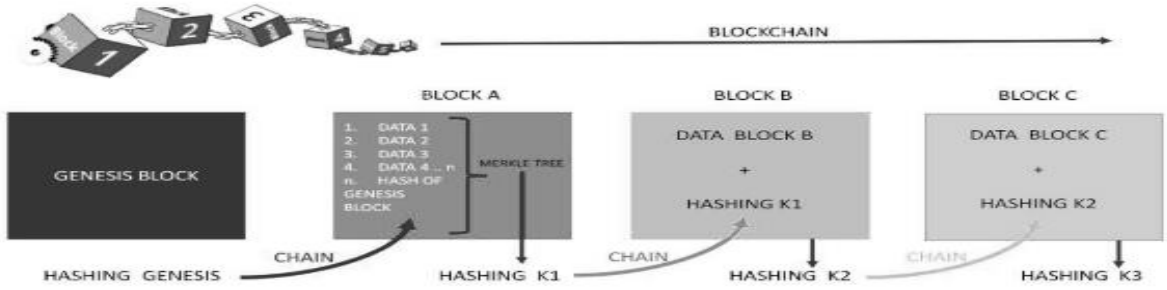


Source: Meiklejohn & Cary (2018)

2.5 Blockchain Architecture

Blockchain is a chain of ordered backlinked blocks that are linked together using cryptography. Each block contains data, a timestamp, a hash of the current block and a hash of the previous block, and a Merkel root. The first block is referred to as the genesis block. Transactions are first hashed, and a Merkle tree is constructed from these hashes. To keep the chronological order, a timestamp is associated with each transaction.

Figure 3: Chain of Blocks

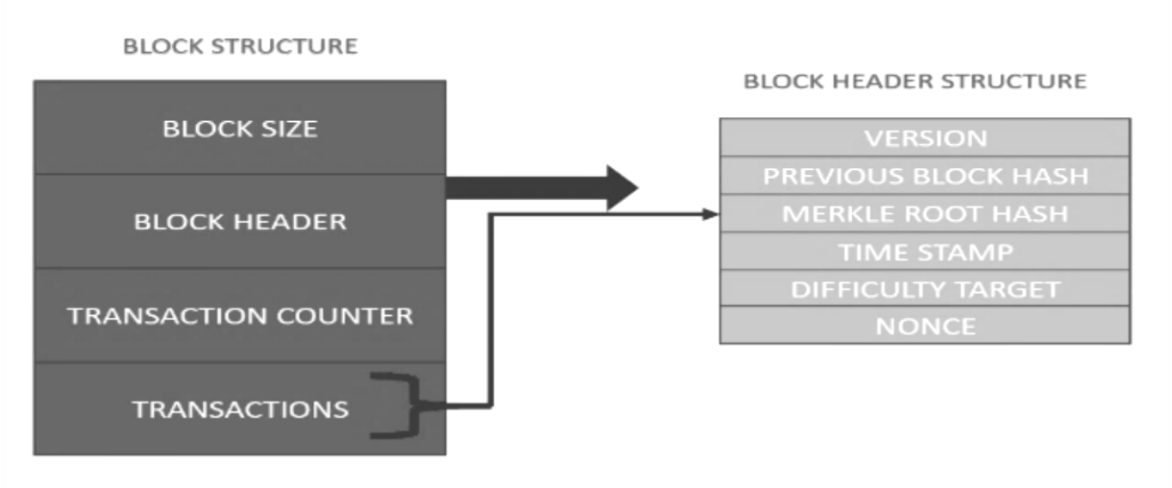


Source: Dwijayanto (2020)

A blockchain block's basic structure consists of four sections, the first of which is the block size. Block size is the number of bytes in a block that contains the hashes of several transactions. The block header

is the second section. The third section is the transaction counter, which displays the number of transactions in a given block. The final section contains the transactions themselves, which are being processed within this block (Dwijayanto, 2020).

Figure 4: Block Structure



Source: Dwijayanto (2020)

2.6 Types of Blockchain

The different blockchain types came into existence based on the need to adapt them to function in various industries. Primarily the two broad types of Blockchain are Public and Private Blockchain. Two variation also exist like the Consortium and Hybrid Blockchain.

2.6.1 Public and Private Blockchain

From public and private blockchains, four major blockchain types can be distinguished: public permissionless blockchains, public permissioned blockchains, private permissioned blockchains, and private permissionless blockchains, as shown in Table 1. The darker dots represent validating nodes, which can validate transactions in the system and participate in the consensus mechanism (Yong et al., 2019)**.**

Table 1: Types of Blockchain

Blockchain type	Explanation	Example	Visualization
Public permissionless blockchains	In these blockchain systems, everybody can participate in the consensus mechanism of the blockchain. Also, everyone in the world with a connection to the internet is able to transact and see the full transaction log.	Bitcoin, LiteCoin, Ethereum	
Public permissioned blockchains	These blockchain systems allow everyone with a connection to the internet to transact and see the transaction log of the blockchain, but only a restricted amount of nodes can participate in the consensus mechanism.	Ripple, private versions of Ethereum	
Private permissioned blockchains	These blockchain systems restrict both the ability to transact and view the transaction log to only the participating nodes in the system, and the architect or owner of the blockchain system is able to determine who can participate in the blockchain system and which node can participate in the consensus mechanism.	Rubix, Hyperledger	
Private permissionless blockchains	These blockchain systems are restricted in who can transact and see the transaction log, but the consensus mechanism is open to anyone.	(Partially) Exonum	

Source: Yong et al. (2019)

2.6.2 Consortium Blockchain

Consortium blockchains, like private blockchains, are intended for multiple organizations. The network can only be joined and maintained by invited and trusted participants. In terms of security, consortium blockchains handle information in a more secure manner for alteration than private blockchains. Because of the participation of multiple organizations, hacking is also better protected in this type of Blockchain. Energy Web Foundation, R3, and other consortium blockchains are examples (Mukherjee & Pradhan, 2021).

2.6.3 Hybrid Blockchains

Public and private blockchains are combined in hybrid blockchains. It combines the privacy and permissioned features of Private Blockchain with the ease, flexibility, and transparency of Public Blockchains. Participants in a Hybrid Blockchain can exert authority over and access to the data stored in it. Dragonchain is the most common Hybrid Blockchain example (Mukherjee & Pradhan, 2021).

2.7 Blockchain Platforms

Table 2 shows a comparison of the major blockchain platforms. The platforms are contrasted in terms of blockchain type, consensus mechanism, smart contract, transaction capacity, forks, lack of permission, and fee-less operation.

Table 2: Blockchain Platform Comparison

	Bitcoin	Ethereum	Hyperledger Fabric	Hyperledger Burrow	Ripple
Blockchain-Type	Public	Public / Private	Private / Consortium	Private / Consortium	Private
Consensus	PoW	PoW/PoS	PBFT	Tendermint	BFT(RPCA)
Smart contract	No	Yes	Yes	Yes	Yes
Capacity	7 tps	12 tps	Thousands tps	Thousands tps	Thousands tps
Forks	Yes	Yes	No	No	No
Permission-less	Yes	Yes/No	No	No	No
Fee-less	No	No	Yes	Yes	No

Source: Abdi et al. (2020)

2.8 Related Works

Weingärtner et al., (2021) discuss some of the frauds in public procurement and propose smart contracts to automate different stages of the public procurement procedure in an attempt to address their major flaws. They created a prototype that demonstrates the process, using sample data to demonstrate the feasibility and usability of their proposal. Fiergbor (2020) also discusses the prospects of Blockchain Technology in Ghanaian Fund Management. His findings revealed that incorporating Blockchain technology into the fund management industry would improve data credibility, transparency, accuracy, accountability, and immutability between fund managers and investors. This is due to Blockchain technology's data storage security features, which make data alteration difficult. The goal of (Sengupta, 2021) is to introduce and present the blockchain concept as well as its current applications in supply networks and logistics. Blockchain technology promises to overcome issues with trust and enable a trustless, secure, and authenticated system of information exchange for supply networks' logistics and supply chains.

In a different line of work, (Olarewaju et al., 2021) offers suggestions for preventing budgetary corruption in government. The study has demonstrated how ICT, in this case social media and a specialized online monitoring platform, can be used to promote accountability and transparency surrounding the government budgeting process. Using abductive reasoning, the article outlines four stages of citizen empowerment and four social marketing transition stages that can help increase budget transparency and decrease corruption. The study (Olu-adeyemi & Okajare, 2020) looked at Nigeria's budget process in relation to the problems that plagued its public budgets. The study raised the issue that Nigeria's budgetary process is secretive, which has prevented fiscal documents from accomplishing their goals. The study concluded that if the budgetary process is made open, transparent, and participatory, the myriad of issues affecting it will be resolved. Reinsberg (2021) investigated how blockchain technology could improve global governance. The study's theoretical analysis revealed that three ways could be used to promote cooperation using blockchain-enabled functionalities such as smart contracts: first, by leveraging collective information feeds to help resolve uncertainty about the state of the world and state behaviors; second, to effectively address distribution issues; and third, to enable states and other actors to interact.

2.9 Research Gap

Blockchain technology has grown in importance as a tool for governments all over the world. However, it is unclear to what extent blockchain can improve the budget process, and some policy domains, such as the national budget process, have not been the focus of recent studies. Budget allocation, in particular, is one of the areas where Blockchain Technology may have the most potential. As a result,

this study attempts to fill a gap, and there is a need for organizations to focus on these issues in order to improve overall operational efficiency

3.0 Methodology

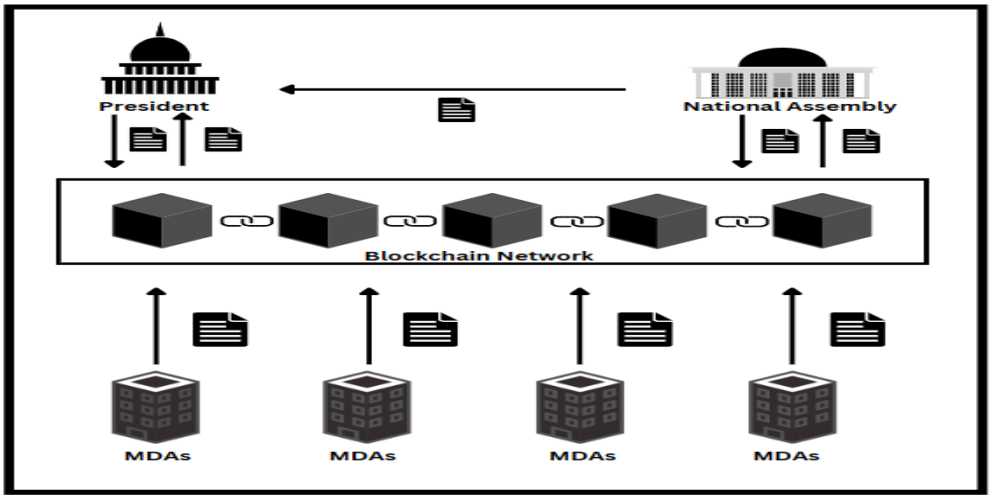
This study employed a qualitative research method, using three approaches such as a literature review, secondary research and case studies, to generate research evidence. With the recent introduction of blockchain technology in government operations, using qualitative approaches gives a realistic strategy to engage with the technology in its early phase. This strategy is used to describe conditions that occur in-depth and in a clear manner. Qualitative research, according to (Tenny et al, 2022), is a sort of study that investigates and delivers deeper insights into real-world situations. Qualitative research is used for preliminary research when the study subject is not clearly defined and poorly understood, to comprehend particular issues regarding the scenario, reality encountered, and to investigate anything in greater depth.

The first step in the research is a review of published literatures on blockchain technology applications in government. The non-financial applications of blockchain technology, such as smart contracts and digital assets, were then examined. Secondary research is carried out on primary sources that cover technical aspects of key blockchain implementations such as Bitcoin, Ethereum, and Hyperledger Fabric.

4.0 Results and Discussions

To discover the benefits that Blockchain Technology can offer to the government budget process, qualitative data collection and analysis were undertaken using a literature study. The literature from top journals and online resource databases such as Google Scholar, Emerald Insight, Academia, Science Direct, Scopus, and Springer Link was searched for primary studies using keywords such as Blockchain Technology, National budget, use cases, and benefits. the literatures were scrutinized based on the relevancy of the abstracts collected, and finally a framework for the national budget process was proposed, as depicted in figure 5, and Blockchain Technology attributes were identified that can repel obstacles encountered during the budget process.

Figure 5: National Budget Process using Blockchain Technology



Source: Compiled by the Authors

Ministries Departments and Agencies (MDAs) of the Federal Republic of Nigeria prepare and arrange the budget in order of priorities and justify in line with their mandates and policy of thrust of government. The budgets prepared by the MDAs are arranged and combined together into blocks of document by the blockchain network. The blockchain network receives individual budget proposals from all the MDAs, and groups proposals together to form a block base on the time they are submitted. As each proposal is submitted, the blockchain network broadcast the proposals to all participants for validation before adding them to a block making the process transparent and preventing the submission of false documents. When the consolidated budget is presented to Mr. President and the national assembly for approval by the Federal Executive council, they are able to compare and contrast the initial budget proposals submitted by the MDAs and the consolidated budget because they are also members of the blockchain before making any approval. Making the budget process efficient and trustworthy. A Harmonization Committee comprised of NASS Appropriations Committee members meet to iron out kinks. Following that, a clean copy of the Appropriation Act is sent to the President for his signature.

This study has explored the budget process and identified certain governmental practices that affect the level of budget transparency. The research findings identified blockchain attributes that can fend off challenges faced by the national budget process.

1. Disintermediation: The elimination of a single point of failure and a potentially vulnerable central authority is a key component of all blockchain technologies. Despite the fact that a central authority controls who has access to the system, blockchains avoid a centralized server architecture. Disintermediation offers two major benefits:

- **Security:** Blockchains are less susceptible to attacks, especially DDoS attacks. There is a distinction to be made between increased external security, which protects records from outside attack, and increased internal security, which makes it more difficult for people within an organization to tamper with the data.
- **Efficiency:** Direct communication between parties can result in significant efficiency gains and quick transaction times.

2. Immutability: Data cannot be changed once it is added to the blockchain. The use of cryptography and the manner in which the data is linked prevents it from being altered later. The data's time and origin can also be determined. The immutability of data can provide two significant benefits:

- **Accountability:** A device or person who entered the data at a particular site on the blockchain and at a particular time can be linked to a transaction. These people can also be connected to the data and made answerable. It is easier and more accurate to identify and attribute fraudulent data**.**
- **Trust:** Because data cannot be changed once it has been entered onto a blockchain, there is more trust in the system. While this is an important feature of cryptocurrencies, it can also be beneficial in other blockchain use cases. They can provide a way to monitor the data that is being stored while trusting that the data has not been tampered with.

3. Transparent: Blockchain technology was built with irreversible transparency in mind. Once a transaction is added to a blockchain ledger, it cannot be modified or removed without causing irreparable damage to the blockchain (Hirsh & Alman, 2019).

4. Anonymity: Transactions in blockchain are made using the generated wallet address, and personal identity is hidden. To ensure complete anonymity, multiple addresses are used.(Banchhor et al., 2021).

Anonymity refers to an entity's status as being secret and unrevealed, which means that no one can determine the users' true identities based on their behavior or transactions in the system.(Hameed et al., 2021).

5. Integrity: The distributed validation mechanisms that confirm blockchain additions cannot be manipulated to intentionally add low quality or inaccurate information to the blockchain. The automated capture of transaction metadata for all activity undertaken on each chain also contributes to the integrity of user information and activity.(NGRI, 2020)

6. Resilience: The distribution of information among blockchain nodes provides the information security that the technology offers. While malicious attacks can target centralized databases, given the distributed nature of a blockchain, a similar level of effectiveness would require "an attack on every copy of the ledger simultaneously."(NGRI, 2020).

7. Autonomy: Autonomy is defined in any system as the ability to perform functions independently in order to achieve specific goals. The anonymity feature of Blockchain allows users to participate in a self-organizing system and to verify transactions without the involvement of a centralized third party.(Hameed et al., 2021).

8. Cryptographically sealed: secures assets recorded on the ledger and ensures the integrity of the blockchain. This increased security enables individuals and businesses to transfer value directly without incurring the additional costs associated with using an intermediary or third-party service to route these payments or trades.

9. Traceability: Because each transaction on the Blockchain is validated and timestamped, users can easily verify and trace previous records by connecting to any node in the blockchain network. Each transaction can be iteratively traced back to previous transactions. It enhances the traceability and auditability of data stored in Blockchain. (Haneem et al., 2020).

5.0 conclusion

The obstacles to a successful budget process are numerous and encapsulated in government corruption. The complexity of corruption undermines the success of most proposed solutions, and thus failures in effective budget processes persist. Further investigating the underlying causes of corruption, we identify government non-transparency and lack of traceability as the primary causes of long-term budget failures. A consensus-driven collaborative national budget framework based on blockchain is recommended to establish communication between government departments.

The blockchain promises tamper-proof records that corrupt bureaucrats will be unable to alter. The distributed ledger and consensus mechanisms make it difficult for a single entity to falsify entries. In the fight against corruption, blockchain has emerged as the most promising disruptive technology. It has important features that can help bureaucracies maintain integrity by securing identity, tracking funds, registering assets, and procuring contracts.

When corruption represents a breach of trust, a technology that builds trust becomes an appealing solution. To conclude, blockchain technology encourages greater participation and awareness by increasing transparency, which will eventually help the Nigerian government develop.

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