# Blockchain: A Potential *Solution* to Public Sector Corruption in Nigeria

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*Abstract—The increasing demands for more transparency in management of public funds globally has necessitated the requirement for open data, application of modern technology to enhance management capacity, and better controls and governance mechanism. In most developing countries, public-sector corruption is the main challenge battling social, economic and environmental development. Often, corruption centers around a lack of transparency, inadequate record-keeping and low public accountability. Blockchain is the next disruptive technology that presents potential that can be used to protect organizations from corruption. Blockchain and distributed ledger technologies, when applied to corruption prone government processes, can potentially increase transparency and accountability in these systems, thereby reducing the prevalence of corrupt activity. Using cryptography and distributed consensus mechanisms, blockchain provides the unique combination of permanent and tamper-evident record-keeping, transaction transparency and auditability, automated functions with "smart contracts", and the reduction of centralized authority and information ownership within processes. These properties make blockchain a high-potential emerging technology to address corruption. This paper explores the possibilities of blockchain applications in Nigeria by examining where it can be used to leapfrog fraud detection and anticorruption in public finance.*

Keywords—Transparency, Corruption, public fund, Blockchain, Accountability, Cryptography'

## 1. INTRODUCTION

Blockchain technology has emerged as a promising tool to address corruption in various sectors, including the public sector in Nigeria. This technology offers features such as decentralization, transparency, and immutability, which can potentially mitigate corrupt practices by making transactions more secure and traceable. The spate of public-sector corruption and weak accountability in developing countries are dumbfounding (World Economic Forum,2020). Public sector-corruption has been identified as the biggest problem battling social, economic and environmental development. According to (OECD,2016), public procurement is arguably one of the government activities most vulnerable to corruption. The corruption risks are escalated by the complexity of the process, the close interactions among public officials and businesses and the multitude of stakeholders. Transparency International defines corruption as "the abuse of entrusted power for private gain". Corruption in public administration erodes trust in government institutions, encourages unfair business practices, discourages foreign investor and decreases access to quality public goods and services (OECD,2016). Corruption may take different forms, ranging from petty frauds to grand illicit transactions. It happens in both the private and public sectors, but it is under the state apparatus where the more harmful effects are perceived (Edimara Luciano et al 2020).These effects present several consequences, namely: a lack of efficiency due to the misapplication of resources, equity loss due to benefits for select groups of stakeholders, bias on reward policies, as they can stimulate misbehavior among civil servants. Corruption in public administration is related to the lack of control and governance, especially in governments where rules of internal controls are unclear, the accountability system is unable to uncover corruption, and the lack of transparency prevails. Nigeria was ranked high in corruption by Transparency International and this has been seen as one of Nigeria's biggest challenge (Mike, 2019). Corruption thrives with lack of transparency, inadequate record-keeping and low public accountability. Most efforts related to the gradual reduction of corruption levels in organizations are focused on legal measures (Edimara Luciano et al 2020).

Blockchain, a relatively new a disruptive innovation with a wide range of applications to provide better management systems in many sectors by constituting trust, transparency, and traceability. Integrating Blockchain technology to services and processes in Nigeria, has the possibility of reducing corruption and enabling better transparency with accountability in Africa's extractives sector (Washbourne, 2018). Blockchain was first proposed in 2008 by Satoshi Nakamoto (Nakamoto, 2008). He made the first bitcoin transaction on a blockchain platform. Subsequently, Bitcoin gain popularity in online transaction due to it characteristics such as freedom of transactions, ease of usage, transparency and global connectivity. Cryptocurrencies like Bitcoin have witness rapid development and user adoption over the past nine years. However, blockchain technologies which powers cryptocurrencies can be leveraged to drive innovation and increase adoption in new domains beyond cryptocurrency.

A blockchain is an encoded digital ledger that is stored on multiple computers in a public or private network. It comprises data records, or "blocks." Once these blocks are collected in a chain, they cannot be changed or deleted by a single actor; instead, they

are verified and managed using automation and shared governance protocols. The blockchain is a peer to peer transaction platform which does not require third-party intermediary. From business purpose, different entities involved in the transaction work as nodes and the process is being validated through cryptography (Sachin Kamble,2019)**.** The ability of blockchain technology to record transactions on distributed ledgers offers new opportunities for governments to improve transparency, prevent fraud, and establish trust in the public sector. Blockchain has the potential to make government operations more efficient by improving the delivery of public services and increasing trust in public sectors. Blockchain applied cryptography and distributed mechanisms to provide a unique combination of permanent and tamper-evident record-keeping, transaction transparency and auditability. It also incorporated automated functions with "smart contracts, and reduction of centralized authority and information ownership within processes. These attributes present blockchain as a disruptive emerging technology that can reduce corruption in public administration.

This paper explores the possibilities of blockchain applications in Nigeria by examining where it can be used to leapfrog fraud detection and anticorruption in public finance.


## 2.0 Overview of Blockchain

Blockchain is a distributed ledger that keep a temper proof history of all activities on a network of connected systems. It is a database of information distributed over a network of computers rather than located on a single or multiple server. Transactions in a blockchain are grouped in blocks while being cryptographically chained in an approach that is immutable; thus generates a mathematically irrefutable history. Blockchain is driven by the presence of a peer-to-peer networks; Merkle trees, asymmetric key encryption, hash values to list a few; making it possible to store data in several locations and still continually reconcile such data through a shared database. Blockchain generates identical blocks of information across the network; this information cannot be controlled by a single entity thus, eliminating a single point of failure. It also has a secure validation mechanism for every transaction on the blockchain; utilising sophisticated encryption technology. Transactions are recorded as temporal and sequential order of occurrence. Previous data on blockchain are immutable yet accessible to users for validation purposes. Updating transactions on blockchain requires the identity verification of the parties involved in the transaction; the updated transactions is also verified by other users. The connection between identities, transactions, and the ledger create transparency; establishing trust on a blockchain network. Thus, making it possible to trace an entity or a transactions path from source to sink with remarkable security and transparency.

## 2.1 Types of Blockchain

Blockchain is classified as public, private and consortium. The Public blockchain is regarded as permissionless while the private and consortium blockchain are grouped as permissioned blockchain.

**Public (Permissionless) blockchain:**
Any person (node) in the world can join public blockchains such as Bitcoin. The participants enjoy equal right in the consensus agreement. All the participants can read, verify and add new valid blocks. Bitcoin is an example of public blockchain. In public blockchain, the nodes have to compete in order to be eligible for adding new block (mining). Issues in public blockchain include privacy, 51%attack and selfish mining .

**Private (permissioned) blockchain:**
Unlike the public blockchain, the participants of private blockchain are known and selected. Only the authorized user is allowed to join, read, verify, add new blocks or participate in the consensus agreement. This blockchain is centralized and mostly used within single organizations and companies like banks for accountability and more security. Private blockchain have lesser issues and threats compared to the public one.

**Consortium (Permissioned) blockchain:**
Consortium blockchain is partially centralized. In this kind of blockchain, some of the users (nodes) are pre- selected to validate new blocks as well as participate in the consensus agreement. The rest of the nodes permissioned to join the network are only allowed read permission. A typical example is a network of say 20 nodes but some selected 5 nodes must sign each block for it to be valid. Consortium blockchain is used by group of organizations acting as a consortium. Examples of consortium blockchain are R3 Corda and Hyperledger.

## 2.2 How Does the Blockchain Work?
IBM's blockchain for dummies (IBM, 2018) explains the blockchain process as thus:
1. Transaction data are stored in blocks that are linked together to form a chain, hence, the name blockchain.
2. The blockchain grows as the number of transaction grows. New transactions are verified using a network algorithm before it is added.
3. The network is governed by rules agreed on by the network participants, which is used before transactions are logged into the blockchain

4. Each block contains a hash (a digital fingerprint or unique identifier), timestamped batches of recent valid transactions, and the hash of the previous block.

5. The previous block hash links the blocks together and prevents any block from being altered or a block being inserted between two existing blocks.

6. In this way, each subsequent block strengthens the verification of the previous block and hence the entire blockchain.

7. The method renders the blockchain tamper-evident, lending to the key attribute of immutability.

Diagrams in Figure 1 and Figure 2 provide a pictorial representation of the blockchain process.
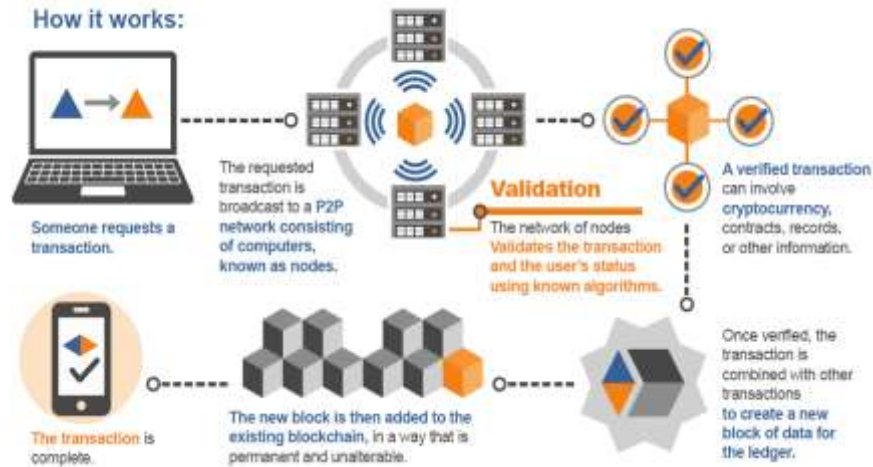


Figure 1. Summary of How the Blockchain Transaction Works
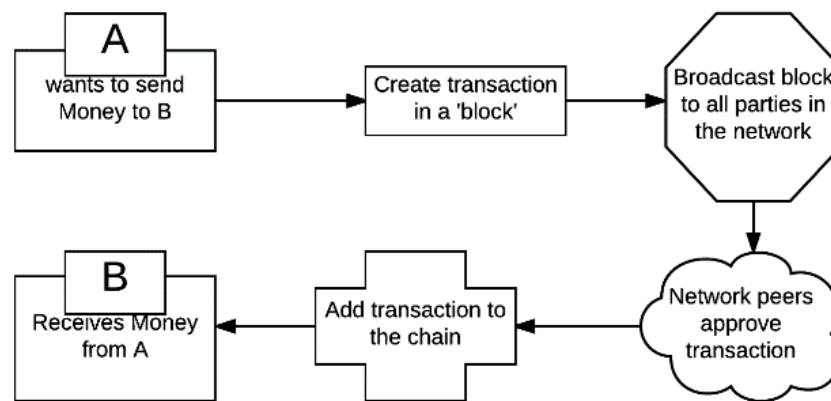Source: (PwC - Next in Tech, 2018)



Figure 2- How a block chain works

## 3.0 Related Works

Momentum has been building up against corruptions for years in developing countries. In Nigeria, the Economic and Financial Crime Commission (EFCC) and the Independent Corrupt Practices and Other Related Offenses Commission (ICPC) were set up to stem corruption within the Nation. Sadly, not much has changed in the last decade. Integrating blockchain technology into some of the anti-corruption programs and systems will drastically reduce the human influence and make the system more efficiency and reliable.

In this segment, we x-ray some of the related work in the use of blockchain to curb corruption in developing countries

Koroye (2023) explores the potential of blockchain technology in combating corruption and enhancing transparency in developing nations. The study highlights that blockchain's features like immutability and decentralization can secure record-keeping, reducing corruption opportunities. Key contributions include the necessity of robust legal frameworks, public-private partnerships, and capacity-building initiatives for effective implementation. Koroye's analysis also emphasizes the importance of aligning blockchain solutions with local needs and existing legal structures to foster accountable governance and sustainable development. The findings suggest that embracing blockchain technology can significantly aid in achieving the Sustainable Development Goals (SDGs) by promoting transparent public administration.

Enihe and Lawal (2021) in their research, explores the potential of blockchain technology as a solution to financial corruption in Nigerian government processes1. The article provides an in-depth analysis of blockchain's applications, challenges, and implementation models, suggesting that blockchain can significantly reduce corruption and enhance transparency in government transactions. The study utilizes data from literature reviews, interviews, and government reports to argue for the adoption of blockchain in managing government finances, proposing a model that includes a Delegated Proof-Of-Stake consensus mechanism and integration with advanced technologies like AI and biometrics for robustness.

Kibum and Taewon (2019) in their article, examine how the blockchain technology could be used to curb corruption and take integrity to higher standards at a firm level, within-country level and cross-country level. Possible risks and challenges related to the technology were identified and found that without considering the data governance and security issues, the blockchain technology may not always lead to a socio-economic benefit.

Ziya Aliyev (2019) in his paper, delves into the reliability of blockchain technology as a tool for anti-corruption. The author looks at how this tool can be utilized to reduce corruption in public administration. The author adopted two-round Delphi Method, the author engaged the services of 17 blockchain experts to assess the potential of the blockchain, the benefits and barriers of blockchain technology in the anti-corruption process. The author addresses the research question of to what extent newly emerging blockchain can be implemented in anti-corruption activities.This research contributes to the literature by providing clarification of the possibilities of blockchain to be used in the anti-corruption activities.

Bart Schermers (2018) in his thesis explores the possibilities of blockchain applications in developing countries, using Kenya as the case study. The research work explored the possibilities of blockchain applications in financial services, trade & aid networks, property registration, elections, and identity management including the potential of smart contracts .The thesis explored blockchain in developing countries by focusing on possible adoption of various blockchain applications that currently exist or are in development, by examining the case of Kenya.

Ebizimoh Abodei et al(2019) adopted a case study methodology to examine the importance of public involvement in addressing the causes of failures in public infrastructural project planning
and -delivery. Using Nigeria as a case, the findings from conducted interviews and a document review support the proposition of a technologically collaborative approach in addressing the causes of public infrastructural project failures. The authors proposed a blockchain-based technical solution to address the problems Corruption. A blockchain-based collaborative tool for managing public project execution was developed

Conducting a free and fair election process is a daunting task in Nigeria. A study by Dogo et al(2018), evaluate the feasibility of using blockchain technology to substitute the current manual or semi digitized voting approach in Nigeria; they adopted the qualitative Strengths, Weaknesses, Opportunities and Threats(SWOT) and Political, Economic, Social and Technological(PEST) analysis approach to propose a strategic direction in adopting block chain Enabled E-voting (BEEV) system in Nigeria.

Peter Eze et al (2017), In their paper, develop an application for executing smart contracts. They focused on those that lead to the transfer of ownership or creation of physical properties in the blockchain. They proposed the 3SmartContract framework. The fundamental approach is to integrate physical and nonphysical assets into a contract platform that automates the technical, business and legal aspects of a contract from initiation to completion.
into
Kshetri, Nir (2017) presents early evidence linking the use of blockchain in overcoming some economic, social and political challenges facing the Global South. The article highlights the key applications and uses of blockchain in developing countries. It demonstrates how blockchain can help promote transparency, build trust and reputation, and enhance efficiency in transactions. The article looks at opportunities and key triggers for blockchain diffusion in these countries. It also delves into challenges and obstacles that developing economies are likely to encounter in the use of blockchain.

Abdurrashid and Cheung,(2019) investigated corrupt practices in developing countries with Nigeria as a case study. They proposed the use of blockchain technology to tackle corruption. A blockchain framework was proposed for tackling public funds embezzlement which was regarded as the biggest corruption related to many corrupt practices.

Apoorva Mohite and Ajay Acharya, (2018) in their article proposed a prototype which was developed using Hyperledger Composer to address corruption. The proposed system would help to monitor government spending and ensure transparency in governance.

## 4.0 The Promise of Blockchain for Government

Innovations and transformations across many aspects of the public sector can be driven by the use of new technologies by governments. The use of information technologies (IT) to improve the public sector is often capture by the label of e-Government .

Blockchain technologies, that are (amongst others) at the core of cryptocurrencies such as Bitcoin, are presented as a major breakthrough with great potential in public sectors. Blockchain has the potential to make government operations more efficient by improving the delivery of public services and increasing trust in public sectors. Also, blockchain applications can be transformative, as it can change the way transactions and recorded. Basically, blockchain is a distributed ledger that is shared among participating parties in a network, used to record transactions that are verified by a consensus mechanism that creates trust in the network. The majority of the participants in the network have to agree to approve the transaction. Once a record is created and accepted by the blockchain, it can never be altered. In this way, the distributed ledger provides an immutable record and ensure traceability of transactions

Several countries such as the USA, the United Kingdom, the Netherlands, the United Arab Emirates, Estonia, Sweden and China announced blockchain initiatives to actively explore its uses in the public sector . Some of the potential benefits such as trust and transparency can be especially beneficial for developing countries since they are more vulnerable to corruption, fraud, and lack of trust than developed countries .
Promoting transparency and reducing fraud and corruption
Blockchain can help achieve transparency in various settings. In mid-2016, Ant Financial, Alibaba's online payments affiliate, announced the launch of blockchain technology for payments. Blockchain was first applied to Alipay's donation platform. Donors on its 'Ant Love' charity platform can track transaction histories, and understand where their funds go and how they are used.The goal is to increase transparency and provide a trust mechanism by recording each payment and spending of donations on the blockchain

Reducing friction and costs of property registration
Blockchain can reduce friction and conflict as well as costs of property registration. Regarding the costs, it is possible to do most or all of the process including the use of a notary service using smart phones.
In mid-2015, the US-based startup Factom and the Honduran government reportedly reached an agreement to transfer land registry in Honduras into a blockchain-enforced digital database. The goal is to create a land title-keeping system that is reliable and transparent
Promoting efficiency in international business to business (B2B) trade and increasing access to trade and supply chain finance
The global trade finance market, which is valued at US$18 trillion, is likely to be transformed by the blockchain by disintermediation and other efficiency measures. First, the global trade finance market relies on paper documentation for most processes
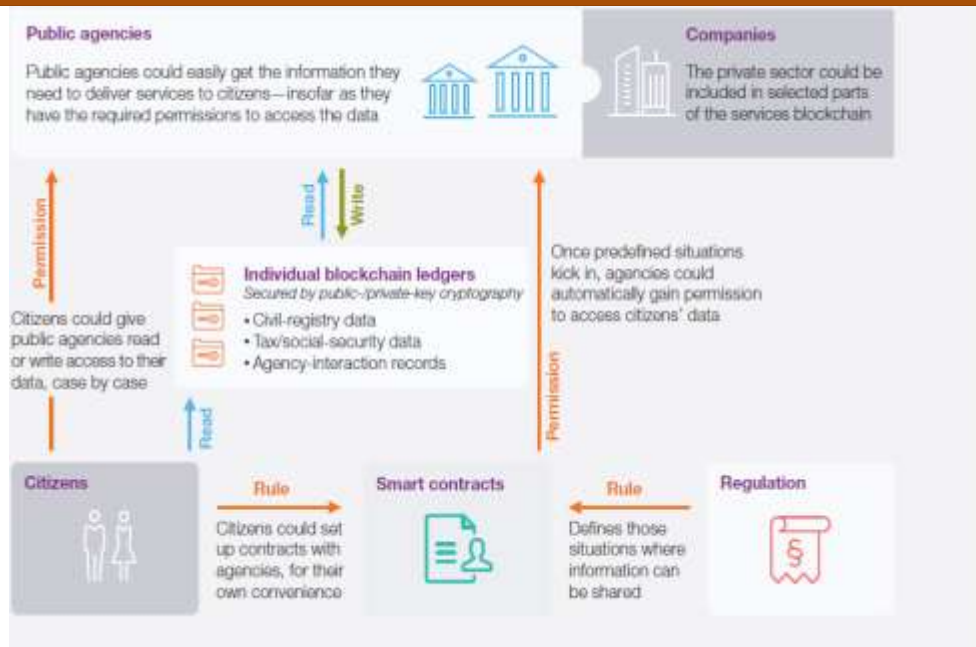
**Security Features of Blockchain**

### 5.0.1 Benefits of the Blockchain Technology

This segment describes some possible areas of adoption of blockchain by government institution for sustainable national development.

According to Lewis, McPartland and Ranjan (2017), the applications and benefits of the blockchain includes:

1. Digital currencies The blockchain facilitates financial transactions with a decentralized currency that crosses borders and eliminates intermediaries. These were the first applications of the blockchain technology as it was the tool behind cryptocurrencies such as the bitcoin. In the era of online and digital banking, cryptocurrencies are becoming increasingly popular and been accepted as a currency exchange in lieu of cash.

2. Digital assets
 The transaction and settlement time for physical assets that require a great deal of verification and examination, such as real estate, stock certificates or gold, is significantly reduced with the blockchain. The verification process is faster, and the risk of fraud is eliminated

3. Record keeping and contract management. A digital audit trail of every transaction is kept, and the details of all parties involved are registered. The blockchain ensures that contracts 19

3. Record keeping and contract management
A digital audit trail of every transaction is kept, and the details of all parties involved are registered. The blockchain ensures that contracts are executed according to the listed conditions. The records are also immutable and easy for interested parties to access or query. Consumers can share records across multiple entities while safeguarding data privacy

4. Finance
The settlement periods between trade transactions can be reduced significantly thereby fostering greater liquidity particularly for trades that have lengthy settlement cycles. The blockchain service with digital identities can be used to reduce settlement times for the foreign exchange sector that uses the global payment system which involves multiple regulatory checks, in addition to passing through settlements banks and commercial banks to facilitate movement of currencies.

5. Asset traceability
Goods can be tracked along the supply chain and throughout the life cycle to improve decision making about inventory management and repairs

6. Tax and Customs
Authorizing and streamlining compliance burdens by executing transactions precisely and reliably while automatically generating documentation

7. Identity Management
Authenticating identity on a blockchain for credential, identity, loyalty and rewards program management

8. Audit and Compliance
It enables real-time transaction level assurance and provides additional transparency to stakeholders

### 5.0.2 Blockchain Applications Against Corruptions

Organizations both in private and public sectors begun exploring thepotential applications of the technology. The technology can disrupt various industries and transform the way we conduct businesses and the role parties play (Bindman 2016). Below examines some cases where blockchain is applied to curb corruption.
Kibum Kim and Taewon Kang,(2019) higlights some of the application of blockchain technology against corruption as thus:

**Food Safety**
Having a complete visibility and transparency on food supply chain is a challenge both for companies and regulators. U.S retail giant, Wall-mart, Tsinghua University and IBM in Beijing are testing the blockchain technology to tackle the food safety issue in China. Using the blockchain technology, consumers can trace back the whole supply chain from its origin. As consumers can identify where the pork came from within China through the blockchain, this certifies and ensures the food quality. The blockchain technology becomes more useful when it combines with the recent IoT technologies such as RFID sensors or QR codes. Without extra manual work to upload information on the blockchain database, the process of certifying the food quality can be automated using such supplementary technologies. Walmart is further expanding the blockchain applications in tracing chemicals in foods and food packaging as well. Blockchain will allow companies pinpoint chemical ingredients, direct and indirect additives and precisely detect any types of manipulation given on food

**Supply chain management:**
Blockchain technology, which enables an end-to -end supply chain transparency reduces the risk of human errors or intentional manipulations by the suppliers or vendors.

**Voting system:**
Blockchain can be applied to ensure that every eligible vote is accounted accurately. This would be a huge step towards democracy and social integrity. Ballot rigging, the act of illegally changing the result of an election by producing a false record of the number of votes, still persists in many parts of the world today. The voting system especially in underdeveloped countries is often a subject of manipulation by a corrupted authority and thus the election result may not always reflect of public opinion. In such circumstances, the blockchain technology can be applied to ensure that every eligible vote is counted accurately without any manipulation and this would be a huge step towards democracy and social integrity.

**Property and real estate management:**
The Blockchain application may act as a watchdog that keeps the government officials supervised while encouraging land owners to officially register their land on the public accessible blockchain network. Corruption on the property and real-estate market is another unresolved issue for some countries. As an example, Honduras is notorious for being one of the most corrupted countries in the world, ranking 123rd on the Corruption Perceptions Index (CPI) by Transparency International. In order to root out the corruptions occurring on land registries, the government of Honduras partnered with a blockchain start-up to develop a system that kept the land record on a transparent and unhackable blockchain platform.

**International trade**
With the help of blockchain technology, trading parties can be better manage the ownership of trade documents and eliminate disputes ,forgeries and double spending risks, The paper-based documents between trading parties and banks, more specifically bills of landing, letters of credits are subject to manipulation, loss and fraud. Also, many regulatory compliances need to be met during the process of international trade, the blockchain technology proves to be beneficial when cross-border transaction occurs at a massive scale. Blockchain can make trade finance documentation more efficient by streamlining processes and integrating the database that were previously spread across multiple parties and databases on a single shared ledger. From the use of the blockchain technology, trading parties can better manage the ownership of documents and eliminate disputes, forgeries and double-spending

risks. The use of smart contract can log the change of ownership and automatically transfer payments to ports upon arrival which can lead to a more efficient and transparent way we trade.

## Foreign Direct Investment (FDI) :

The blockchain technology has also been reviewed by NGOs and charity organizations to eliminate the misappropriation of funds. By keeping all financial transactions involved in the charitable activities on a public ledger, the charity donor or aid country can track and monitor whether the money is spent on right purpose. This would be valuable to international organizations such as the World Bank in tracking where the loans are being spent within the borrowing countries' borders. International organizations that provide FDI to the under-developed world can track every dollar and this will ultimately lead to a more efficient use of resources.

## Risks and Drawbacks of Blockchain Technology

Despite the abundant application areas of the blockchain technology in combating corruption, it also has various risks and challenges that need to be addressed. Without considering them prior to its adoption, the price to pay for this revolutionary technology may surpass the benefit we expect from it ,Despite the solutions currently offered by both Blockchain and Openchain technologies for implementing smart contracts, lots of problems still impede the wide adoption of smart contract technologies.

## Data Governance and Security

The disclosure of information among participants within a supply chain may lead to infringement of credential data and distortion of the market structure in an unintended way.

## Resistance from the Incumbents

Blockchain may substitute the role of trusted parties including traditional bank and clearing houses. As a result, the incumbents tend to use regulations to raise the entry barrier.

## Lack of Support from the Top Management

As most corruptions in the under-developed countries stem from the top management, the diffusion of the blockchain technology through a top-down approach remains as a challenge

## Maladaptation of the Technology for Illegal Purposes

The blockchain technology can be misused by the fraudsters to find areas of vulnerability to penetrate. As an example, Bitcoin and cryptocurrencies have been linked to illicit transactions

## Conclusion

Blockchain technology is an emerging technology capable of disrupting many systems and allowing them to improve in terms of data security, speed, efficiency, immutable record, autonomy and reduced cost. Corruption in public sectors have been regarded as the main bane to social and economic growth especially in developing countries. We have explored the potentials of blockchain technology as a solution to addressing the problem of corruption in Nigeria. We believe that blockchain technology can help immensely in fighting corruption when harness properly to usher development in developing countries. Despite the potential opportunities, this paper finds that the blockchain technology is not a universal solution that will resolve all corruption issues we are facing. Without considering the side effects of the technology, the price to pay may surpass the benefit we expect from eradicating corruption

## 6.0 Recommendation

We recommended the following measures to ensure a successful and seamless integration of blockchain technology into public administration in Nigeria:
☐The use of the Open Contracting Data Standard (OCDS), a framework defining a common data model for the disclosure of data and documents in government contracting processes, including those for public procurement, should be considered.
☐Basic digital literacy for government employee on the benefits inherent in blockchain technology
☐The Ministry of communications and Digital Economy should put in place infrastructures that can drive the implementation of blockchain technology in Nigeria within the government.
☐The Federal government should integrate blockchain technology into the IPPIS(Integrated Payroll and Personnel Information System) and TSA(Treasury Single Account) software to reduce the incessant corrupt practices that have characterized the system
☐The Federal  government should endeavor to embrace an holistic e-government system.

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