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RESEARCH ARTICLE

BLOCKCHAIN TECHNOLOGY IN SECURING INDUSTRIAL COMMUNICATION NETWORKS IN ABUJA, NIGERIA: OPPORTUNITIES AND CHALLENGES

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ABSTRACT

Blockchain technology is beginning to reveal itself as a fairly viable solution for supporting the security of industrial communication networks especially in networks which are often under a cyber-threat. This paper aims at analyzing the use of blockchain technology in the protection of industrial communication networks in Abuja Nigeria in the framework of theories relating to decentralizing; network security and data integrity. The concept of shared ledger and decentralized control in the blockchain system state the theory of network security correctly as it reduces the vulnerability to cyber-security threats by avoiding any central control point. Further, based on data integrity theory, the blockchain has an immutable ledger where different pieces of data are transferred, which makes those data accurate and reliable. This paper focuses on the perception of industrial communication in the present day Abuja environment, the security threats encountered and the prospect of blockchain in solving these threats. By use of case studies and a review of literature, the paper reveals the prospects and challenges of the use of blockchain technology in Abuja industrial segments.

Keywords: Blockchain, technology, industrial communication, network, security,

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1.0. INTRODUCTION

Industrial Communication Networks in the Digital Age: These have emerged as the strong foundation of today's industrial Mail and one that supports every organization be it in manufacturing or the service sector, through coordination, flow of data, programs and updating of various systems and controls in real time. However, by depending on these networks, they have also opened a Pandora's Box to numerous risks for instance data piracy, and hacking, and fraud. To some extent, with a focus on Nigeria here, particularly in Abuja where industrial growth is linked to the growth of the nation's economy, safety of such carrier communications is highly valued.

Blockchain, identified by decentralized, transparent and non-adjustable characteristics, can help solve these security issues. Initially, blockchain technology was created with an aim of handling financial operations in the context of the crypto currency market, however, in the meantime, it has found a number of applications, such as protecting industrial control networks. This paper aims at analyzing the possibility and prospects of the use of blockchain technology in increasing the security of industrial communication networks in Abuja, Nigeria through studying the application, benefits as well as drawbacks of this technology.

2.0. THEORITICAL REVIEW AND CONCEPTUALIZATIONS

2.1. **Theoretical Framework**: This study on the application of blockchain technology in securing industrial communication networks in Abuja, Nigeria, is anchored on several key theories: These include Decentralization Theory, Network Security Theory and Data Integrity Theory. These theories suggest various assumption systems of the world and give a foundation of the indispensable role of blockchain as well as its drawbacks in enabling industrial communication networks.

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Decentralization Theory: Decentralization theory stresses the point that decentralization involves distributing the decision-making mechanisms in a network rather than concentrating them at a given point. Regarding the conditions in the sphere of technologies based on blockchain, decentralization is of great importance to increase the security and reliability of the communicational networks. As distinguished from traditional centralized systems that make a single point of control vulnerable to compromise, the control on the blockchain network is decentralized among the nodes.

The notion is in a concordance with the decentralization theory since it eliminates risks, strengthens the network against attacks, and directs the users' trust towards the network. Talking about the communication network that is crucial for operations in Abuja where the industrial sector was focused, the application of decentralization through the blockchain can help to overcome such threats that are connected with the centralization of the control. Here, the decentralized nature of blockchain technology reduces these networks' dependence on specific centers thereby increasing their resilience against threats and operations interferences.

Network Security Theory: According to the theory of network security, it is aimed at safeguarding the data and the resources in a network from being claimed for an improper use or handicapped. This theory forms the basis for the various forms of communication network security protocols that are implemented in different systems. Cryptographic algorithms and consensus mechanism that forms the base of blockchain technology fits well with theoretical frameworks of network security as it offers a secure distributed environment to exchange and store data. The theory of security in this case mostly focuses on key issues such as encryption, authentication and access control, which are already advocated by the architecture of the blockchain technology.

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Blockchain is effective in industrial communication networks in securing transactions and communications especially for contexts such as Abuja where the security of data is extremely critical; this is by creating permanent records and employing cryptographic techniques so that only specific user have access or permission to alter data. Data Integrity Theory Data integrity theory relates to the quality of data, and its coherence and credibility while passing through its life cycle. It postulates that data must be accurate, complete, immutable and intelligible only to the permitted end users. The aforementioned theory is well supported by blockchain since the technology creates an unalterable ledger that stores each transaction or data entry in a format that cannot be changed upon validation. Data integrity is a fundamental concept in industrial operation to keep up with compliance and the functionality of the organization's data in decision-making. Blockchain gives assurance that all information exchanged by the various industries of Abuja are correct and reliable, hence eliminating factors such as mistakes, fraud, and hacking. This is especially so when the operational environment requires accurate data as a key success factor.

Integration of Theories in the Study

Application of theories is a major aspect of study as they enhance the understanding of the events and occurrences in the society. The understanding of the theories of decentralization, network security and data integrity thus gives the broad framework for the study on the applicability of blockchain technology in securing industrial communication networks in Abuja. Hence, by operationalizing these theories, the study not only analyses the technological usefulness of blockchain but also brings into perspectives the impact that the implementation of blockchain might have in industrial processes, security and management. This theoretical framework informs the study on the possibilities of using blockchain in improving security, increasing trust

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and maintaining data integrity in the industrial communication networks of Abuja, hence promoting the industrial growth in the area.

2. 2 CONCEPTUALIZATIONS

2.2.1. Blockchain Technology Overview

Blockchain entails a wide variety of transactions that are stored on a distributed computer platform termed as nodes and upon each transaction, the data remains irreversible and transparent. A block in a blockchain consists of a hash of the previous block, a timestamp, and the information of the transaction that has occurred. Such structure also ensures that nobody can change information without the consensus of the network making it extremely secure and reliable.

Blockchain uses consensus model whereby all nodes connected in the network must approve the validity of the transaction before they are recorded on the chain. This approach helps eliminate the desire for a central control authority, thus also making blockchain resistant to cyber criminals and alteration of data.

2.2.2. Industrial Communication Networks

Industrial communication networks imply the approaches for managing, monitoring and controlling the industrial processes occurring in all types of industries, such as manufacturing, energy and Logistic industries and construction industries. These networks allow information interchange between machines, sensors, control systems and operators and actual decision making and automation.

Therefore, protection of industrial communication networks which is a key factor in enabling smooth running of industrial processes cannot be overemphasized. In these networks, including

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any subpar compromise means operational interferences, monetary waste, and at times, insecurity. The current security protocols like the firewalls and encryption have been found wanting especially due to the new and more complicated threats in cyber space hence development of a new concept like blockchain**.**

3.0. METHODOLOGY

This research adopts a Cross-sectional/Descriptive research approach and more specifically, case studies, surveys and literature review. The literature review concentrates on four specific subjects: the adoption of blockchain technology in industrial communication networks, its impacts, benefits and possible challenges that may be experienced all over the world. The paper seeks to explore real life examples of blockchain with special reference to some Countries including Nigeria about its possibilities.

Competent interviews were held with different organizations and professionals who work with industrial communication networks and cyber security experts, high-range blockchain developers within the Abuja region. From these kinds of source the collected qualitative data was used to extract themes, issues and prospectus relating to block chain technology in the enhancement of securing industrial communication networks.

4.0. DISCOURSES

4.1. The Current State of Industrial Communication in Abuja: Overview of Abuja's Industrial Landscape

Being a capital city of Nigeria, industries that exist in Abuja include; government activities, telecommunication, construction and energy. Some of the benefits of the city include; it is

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located in a strategic position and also being the administrative capital, there are a lot of industrial activities and many national and multinational companies that invest in the region.

The industrial communication networks in Abuja play a major role in the efficient running of these sectors. Such networks facilitate the various processes that require management such as logistics, control of production processes, and development of various installations. Nonetheless, these networks are significant today and at the same time, cognizant of dangers of security breaches caused mostly by aggressive reliance on digital technologies**.**

4.2. Challenges in Securing Industrial Communication Networks

The industrial communication networks in Abuja experience several challenges as regards to security. These include:

• **Cyber security Threats**: Applying such industrial processes make the processes integrate, and the result is that they are vulnerable to cyber-attacks. Malicious users can interfere with and possibly penetrate communication systems to obtain confidential information or take control of an organization's functions or even destroy industrial appliances.

• **Data Integrity Issues**: This paper published on IEEE xplore aims to establish notarize and trustworthy data communications over the industrial Internet. But data leakage and its modification can cause mistakes in decision-making, in operations, and losses of money.

• **Lack of Standardized Security Measures**: Since there are no specific security measures adopted by different industries in Abuja, maintaining a standard and reliable security measures is relatively complicated. It puts the security of information at a high risk of compromise due to these gaps that are time and again created.

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4.3. Application of Block chain in Securing Industrial Communication Networks

Block chain has unique features that will help in securing industrial communication networks as described below. These include:

Enhancing Data Integrity: The use of Block chain therefore provides data integrity since the records of the various transactions cannot be changed. Every transaction is processed and entered into the distributed ledger through the network making it impossible to make adjustments without the consent of the network. Indeed, in industrial communication networks this feature may be most important to guarantee the accuracy of data related to production, supply chain management as well as to various operational processes. In Abuja it was also established that its specific industries like construction and energy can advantageously use the blockchain technology for precise records keeping on materials and equipment as well as processes. Through data capture in the process of communication, blockchain decreases the probability of mistakes and brings the participant a constant and accurate information**.**

Securing Supply Chains: The Abuja industries' focal issue is supply chain security since the mobility of products and materials is essential for industries. Blockchain can be used to record the movement of the products and the materials used in producing it with complete tracking of supply chain until the very end. For instance, in the construction industry blockchain contracts can be utilized to monitor the procurement and transportation of the building materials in the construction site to ensure they are permitted materials in construction. Besides increasing safety, it also makes optimum use of resources and minimizes time and mistakes that are often associated with supply chain management.

Reducing Cyber Security Risks: Given this characteristic of block chain, a network built on this technology will inherently be shielded from cyber criminals. This is different from the

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traditional centralized systems whereby one can easily control the entire network by duplicity as the data is stored in several nodes in the block chain technology.

Blockchain can be a safety feature in cities such as Abuja where industries are now being threatened by hackers. Through the use of blockchain in the industries, they are able to secure their communication networks with the objective of minimizing the impact of cyber criminals who may attempt to jam the communications systems.

4.4. **The Problems with Implementing Block chain in Abuja Industrial Networks**

Challenges for Utilizing Blockchain Technology in Abuja Industrial Communication Networks Despite its potential advantages, using a blockchain technology in industrial networks of Abuja will instead face various challenges.

Technological Barriers : The application of blockchain technology for deployment needs a good amount of computing skills, which perhaps some sectors in Abuja might be deficient in. Designing and maintaining a blockchain platform requires highly skilled endeavours such as the paid professions in programming, security in cryptographic, as well as network administration. Furthermore, the inclusion of blockchain technology into the already existing designs is also poor; this procedure is often quite resource and time intensive.

Regulatory and Legal Issues : As far as the legal aspects of blockchain technology in Nigeria is concerned, there is very little or no order at all. The term ‘blockchain’ is gaining greater traction as time progresses, but implementation of the technology comes with questions and apprehension from users due to lack of legal or regulatory framework. Industries in Abuja may be left in ambiguity as to issues of compliance, management of sensitive information and intellectual property in the usage of blockchain technology.

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Cost Implications: The first stage cost to introduce blockchain technology can appear quite high, especially to the small and medium sized enterprises (SMEs) companies in Abuja. There are organizations that are ready to embrace the quick application of the new trends; however, these organizations can be limited by the expenses necessary to develop blockchain applications, train personnel and upkeep the system. On top of that, one can expect crypto currency hardware and infrastructure such as servers and communication lines necessary to install and run the blockchain to be expensive too. The sectors in Abuja have to weigh all the costs of going for the blockchain technology and if it is worthy considering the benefits that are anticipated out of it.

4.5. Case Studies

Blockchain in Nigeria's Oil and Gas Industry: The oil and gas sector in Nigeria has shown interest in the application of blockchain technology in an attempt to make their operations more secure and efficient. One such instance is the application of technologies like blockchain to consolidating information flow between oil rigs, refineries and distribution depots. Segments of the industry have benefited from these services by recording oil production, movement and sales on a blockchain which has made it possible to finish all the transactions without manipulation. Fraud has decreased, there is greater accuracy in data and the security of the entire supply chain has been marketed for improvement. In Abuja, the proven efficacy of blockchain in relation to the oil and gas industry can inspire other sectors wishing to enhance the security of their networks with success. The insights gained from this case study can benefit other industries such as construction and telecommunications on issues of security and efficiency.

Blockchain in the Energy Sector - Securing Power Distribution Networks: Power distribution in Abuja, the energy sector specifically, has many security concerns, for instance: Security of Network, security of data, and data access. DisCos manage lots of data on how

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electricity is consumed, billing and electricity grid data. The integrated IT architecture, common in most of the organizations exposes such systems to a significant amount of cyber threats and data loss, in addition to increasing the amount of operational inefficiencies.

Blockchain Application : However, power distribution network management issues (related to DisCos) have also been partly addressed through the use of Blockchain technology, which goes beyond the integration of the energy distribution network architecture by creating an ecosystem that is not susceptible to tampering. In Abuja, whereby information would be shared among DisCos and consumers and regulators based on blockchain, the information would be protected. Smart contracts could control this issue. In this case, intelligent contracts could be programmed to conduct electricity trade management as to protect bill exchange from errors and cessation of consensus validation. Also, the resilience of the grid will be strengthened if most of the access and control of core systems are done through blockchain.

Impact : The application of blockchain in Abuja's energy sector could lead to significant improvements in data integrity, operational efficiency, and customer trust. By securing communication networks within the power distribution system, blockchain can help reduce fraud, prevent unauthorized access, and ensure the reliable delivery of electricity to consumers. Furthermore, it could provide a secure and transparent platform for managing energy transactions, thereby fostering greater accountability and reducing disputes**.**

Blockchain for Supply Chain Security in the Manufacturing Sector

In Abuja, Nigeria, the manufacturing sector plays a crucial role in the country's industrial landscape, with many companies depending on intricate supply chains for the production and distribution of goods. These supply chains involve multiple participants, including suppliers, manufacturers, distributors, and retailers, and ensuring the integrity and security of

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communication within these networks is vital for the smooth flow of goods. However, issues such as fraud, counterfeiting, and inefficiencies often compromise this integrity.

Blockchain Application: Blockchain technology can be employed to secure and streamline communication networks within Abuja's manufacturing sector's supply chains. Through the implementation of a blockchain-based system, all transactions and communications between stakeholders can be recorded on an unchangeable ledger, guaranteeing transparency, traceability, and security at every stage of the supply chain. For instance, manufacturers can track the origin of raw materials, monitor production processes, and verify the authenticity of goods.

Impact : Blockchain technology can be employed to secure and streamline communication networks within Abuja's manufacturing sector's supply chains. Through the implementation of a blockchain-based system, all transactions and communications between stakeholders can be recorded on an unchangeable ledger, guaranteeing transparency, traceability, and security at every stage of the supply chain. For instance, manufacturers can track the origin of raw materials, monitor production processes, and verify the authenticity of goods**.**

The adoption of blockchain technology in Abuja's manufacturing supply chains has the potential to significantly improve security and efficiency. By providing a single source of truth for all supply chain data, blockchain reduces the risks related to fraud and counterfeiting and enhances traceability and accountability. Additionally, it could result in cost savings by reducing the reliance on intermediaries and manual record-keeping, thus enhancing the overall competitiveness of the manufacturing sector in Abuja

Blockchain for Secure Government Communication in Abuja : In Abuja, the Nigerian government has acknowledged the potential benefits of blockchain technology in securing its communication networks. Several government agencies have begun to explore blockchain

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applications to safeguard sensitive data and ensure the integrity of official communications, especially in critical functions such as national security, financial management, and public health. The government's efforts to integrate blockchain in Abuja provide valuable insights into the challenges and opportunities associated with implementing the technology in various industries. By examining the government's experience with blockchain, industries in Abuja can gain a better understanding of the practicalities of adoption and the potential benefits.

5.0. CONCLUSION

Blockchain technology holds significant potential for securing industrial communication networks in Abuja, Nigeria, as it has the capability to enhance data integrity, secure supply chains, and reduce cyber security risks. However, the successful implementation of blockchain technology in Abuja necessitates overcoming several challenges, including technological barriers, regulatory uncertainties, and cost implications. To fully leverage the advantages of blockchain, concerted efforts from both the government and the private sector are needed.

As industries in Abuja increasingly embrace digital technologies, the significance of securing communication networks will only grow. Block chain offers a powerful tool for enhancing security, but its adoption must be carefully planned and supported by appropriate policies and regulations. With the right approach, blockchain technology can play a crucial role in driving the secure and sustainable development of Abuja's industrial sector.

Competing Interest

The authors have declared that no conflicting interest exit in this paper

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