

Enhancing Security and Accessibility of Personal Records in Nigeria using Blockchain Technology: A Case Study of Modibbo Adama University, Yola

Suleiman Sa'ad^{a*}, Abubakar S. Chul^a, Mohammed B. Ribadu^a, Abubakar Mohammed^a

^aDepartment of Information Technology Modibbo Adama University, Yola 640231, Nigeria

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ABSTRACT

The security and accessibility of personal records have become critical challenges in Nigeria, given the country's reliance on outdated and vulnerable systems for managing sensitive data. This research explores the role of blockchain technology in enhancing the security and accessibility of personal records in Nigeria. Blockchain, known for its decentralised, transparent, and tamper-resistant nature, offers a promising solution to issues such as data breaches, unauthorized access, and inefficient record-keeping. The study investigates how blockchain can provide a more secure and reliable infrastructure for managing personal records, focusing on key attributes such as encryption, immutability, and data transparency. It also examines the potential for improving accessibility, especially in areas where record retrieval is often delayed or compromised by bureaucratic bottlenecks. By evaluating case studies and existing applications of blockchain technology in record management, this research identifies opportunities and challenges for blockchain adoption in Nigeria's public and private sectors. Through a mixed-method approach that includes surveys and interviews with key stakeholders in data management, the study highlights the feasibility of integrating blockchain into Nigeria's personal records system. The findings suggest that blockchain technology, despite certain challenges such as cost and technological infrastructure, can significantly enhance the security and accessibility of personal records in Nigeria. Recommendations for policy development, technological investment, and further research are also provided.

1. Introduction

The concept of blockchain was introduced as a fundamental component of the digital currency Bitcoin by (Nakamoto, 2008). Initially designed as a method for transferring Bitcoin from one party to another, blockchain technology has evolved significantly and is now utilised by numerous large companies to monitor and manage various assets globally, akin to sending an email. As noted by Del Castillo (2019), Associate Editor at Forbes, the utility of blockchain has expanded far beyond its original purpose. A survey conducted by Gartner found that only 2% of higher education respondents had implemented blockchain, while 18% planned to adopt it within the next 24 months. However, nearly half of the respondents (about 47%) expressed a lack of interest, with many taking a cautious wait-and-see approach due to the prevailing hype, immaturity, and perceived risks associated with blockchain technology (Moore, 2019). At its core, blockchain functions as a distributed database that maintains a continuously growing list of ordered transaction records, known as blocks. Each block not only contains the stored data but also links to the preceding block, effectively creating an open ledger that captures transactional data in a permanent and verifiable manner.

Furthermore, in Nigeria, the management of personal records has encountered significant challenges, including security vulnerabilities and accessibility issues. Traditional centralised systems have struggled to maintain the integrity and confidentiality of personal data, raising concerns about data breaches, identity theft, and inefficiencies in record-keeping practices. This chapter provides an overview of how blockchain technology emerges as a viable solution to address these challenges, enhancing the security and accessibility of personal records in the country. Personal records such as birth certificates, educational qualifications, medical records, and identification documents play a crucial role in various transactions and interactions within Nigeria. However, the current methods of storing and accessing these

* Corresponding author. Tel.: +2348033516997

E-mail address: suleimanu@mau.edu.ng (Suleiman Sa'ad.)

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records are often inefficient, insecure, and susceptible to fraud and manipulation, primarily due to reliance on outdated paper-based systems and centralised databases that are vulnerable to hacking and unauthorized access (Eke *et al.*, 2022).

Hence, blockchain technology offers a robust solution to these prevalent challenges by providing a secure, tamper-proof method for storing and accessing personal records. As a decentralised and distributed ledger, blockchain records transactions in a transparent and immutable manner. Each transaction undergoes verification by a network of computers (nodes) before being added to a block, which is then linked to prior blocks in the chain. This process effectively prevents any alteration or deletion of records once they are added, ensuring data integrity and security. Given the longstanding issues surrounding the storage and management of personal records in Nigeria, blockchain technology presents an opportunity to overcome inefficiencies and enhance data protection, thus transforming the landscape of personal records management (Tripathi *et al.*, 2023).

According to Akanfe *et al.* (2024), despite the promising advantages of blockchain adoption for personal records in Nigeria, several barriers and considerations must be addressed. These include concerns related to data privacy, regulatory compliance, interoperability with existing systems, and scalability. Resistance to change from traditional institutions, along with apprehensions about the adoption of emerging technologies in sensitive areas such as personal records, may also hinder progress. This study aims to explore the role of blockchain technology in enhancing the security and accessibility of personal records in Nigeria, focusing on the current challenges, opportunities, and implications associated with its implementation. By examining these critical issues, the paper seeks to achieve the following objectives:

- i. Examine the challenges facing current personal records management systems in Nigeria.
- ii. Investigate how blockchain technology can address these challenges and improve the security and accessibility of personal records.
- iii. Assess the potential impact of blockchain adoption on various stakeholders, including individuals, government agencies, and service providers.
- iv. Identify barriers to the adoption of blockchain technology in the Nigerian context and propose strategies to overcome them.

2. Literature Review

This section provides an in-depth review of the existing literature on personal records management, blockchain technology, and previous studies related to the adoption of blockchain in Nigeria. By synthesizing relevant research and scholarly works, it establishes a foundation for understanding the challenges and opportunities associated with using blockchain technology to improve the security and accessibility of personal records in Nigeria. It highlights key themes such as data integrity, privacy protection, and efficient record-keeping practices, while also addressing the significant challenges faced by centralised systems, including data breaches and difficulties in accessing and updating records. The literature on blockchain technology underscores its potential as a transformative innovation across various sectors, including personal records management. It explores the decentralised, immutable, and transparent nature of blockchain, which ensures data integrity and security. Important concepts such as distributed ledger technology, consensus mechanisms, smart contracts, and cryptographic hashing are discussed, along with the potential applications of blockchain in identity management, supply chain logistics, and financial transactions (Gad *et al.*, 2022). Furthermore, the section emphasizes that blockchain serves as a digital ledger system that allows for the tracking of digital assets without the need for centralised record-keeping, enabling participants to verify transactions through consensus agreements and preventing fraudulent activities, as depicted in Figure 1.

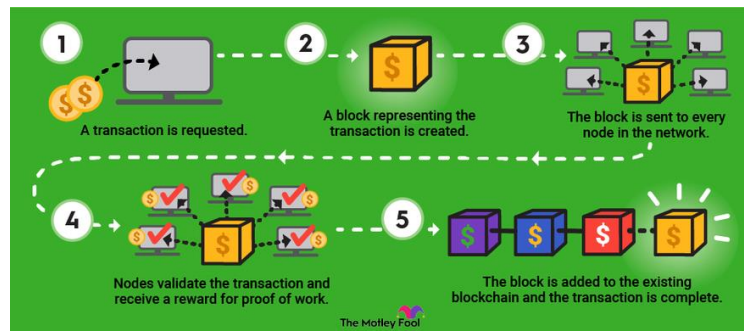


Figure 1 Blockchain process (Bylund, 2023)

Blockchain technology has found extensive applications across various fields, particularly in the realm of cryptocurrencies like Bitcoin, Ethereum, and Zcash. Bitcoin, established as the first peer-to-peer electronic cash system, employs a hash-based Proof-of-Work (PoW) consensus algorithm to maintain agreement among nodes within its distributed network. In contrast, Ethereum offers a public platform for smart contracts using a proof-of-stake consensus method. The evolution of blockchain applications can be categorized into three stages: Blockchain 1.0 focuses on cryptocurrencies; Blockchain 2.0 expands applications to include various financial instruments; and Blockchain 3.0 explores further uses beyond finance, encompassing sectors such as government, healthcare, and education. The decentralised nature of blockchain is particularly valuable, promoting a shift in power dynamics from centralised authorities to peer communities, while ensuring data security and privacy in exchanges (Abrar and Sheikh, 2024). Furthermore, in education as in the study of Çelik and Baturay, (2024), blockchain is emerging as a transformative tool for securing and managing records, such as transcripts and diplomas, which are vulnerable to fraud—especially given the prevalence of fake diplomas. Solutions like MIT's Blockcerts Wallet enable the issuance and verification of blockchain-based certificates, offering a robust defense against credential fraud. The peer-to-peer architecture of blockchain enhances security and privacy, while cryptographic methods provide instant verification of educational records. Blockchain can also standardize record management across institutions, ensuring that data is easily accessible and securely shared. With its potential for creating a transparent and decentralised record-keeping system, blockchain not only simplifies the verification of credentials but also supports the inclusion of diverse educational achievements, such as vocational and corporate training records. The proposed Blockchain-Based Educational Record Management (BERM) system as shown in Figure 2, would utilise a consortium model, allowing authorized personnel to create records while enabling public verification of their authenticity, thereby streamlining record management processes in educational institutions.

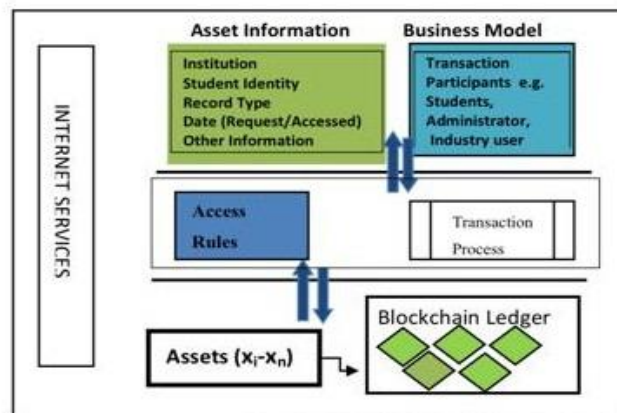


Figure 2 BERM Basic Operational Components (Idowu *et al.*, 2023)

The proposed Blockchain-Based Educational Record Management (BERM) system architecture follows a structured flow involving transaction initiation, request, and verification. First, an authorized individual requests the creation of an educational record transaction. This request is then sent to the nodes within the BERM system for processing. Upon receipt, the transaction is verified through the blockchain ledger, and once confirmed, a new block

corresponding to the educational record transaction is created and permanently annexed to the ledger, ensuring its immutability and completing the transaction process. This workflow ensures that educational records are securely and efficiently managed within the BERM framework (Idowu *et al.*, 2023).

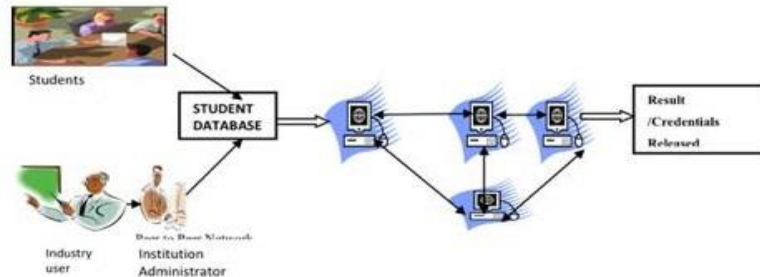


Figure 3 creation of record transaction, (Olawoyin *et al.*, 2020)

Moreover, the paper outlines the process of writing educational records to a blockchain account, which involves an administrator creating a record that is saved and time-stamped in a block. This block is validated through cryptographic techniques by pre-selected network nodes and subsequently added to the blockchain, ensuring that all users have access to a consistent ledger. By utilising a credential such as an ID card through a web browser, users can easily access educational records with guaranteed authenticity and integrity. The section then transitions to an empirical review of blockchain adoption in Nigeria, emphasizing its early stages and potential impact across sectors, particularly regarding financial inclusion, transparency, and fraud reduction.

The literature further highlights the importance of securing personal records to protect privacy and prevent fraud, pointing out the vulnerabilities of centralised systems. Blockchain technology presents a promising solution by enhancing data integrity and confidentiality through its decentralised, immutable structure. However, concerns regarding privacy and transparency arise, especially in public blockchains. The need for regulatory frameworks and compliance measures is crucial to address these challenges. Additionally, blockchain can alleviate accessibility issues associated with traditional systems in Nigeria, offering individuals control over their identity and personal records. While blockchain fosters transparency and accountability in record management, it is vital to address the digital divide to ensure equitable access to its benefits. Largely, the section underscores the potential of blockchain in enhancing personal records management while identifying gaps in the literature, particularly in the Nigerian context.

3. Methods

The research design employed in this study was a descriptive survey method, which aimed to gather relevant information without manipulating independent and dependent variables. The focus of the study was Modibbo Adama University, Yola, a public research institution in Adamawa State, Nigeria, known for advancing science-based research and offering various degree programs under the leadership of Vice Chancellor Prof. Ibrahim Umar. The study's population comprised lecturers and students from this university, with a total sample size of 300 respondents selected through simple random sampling. This included 10 lecturers and 90 students randomly chosen from first, second, and third-year classes, particularly focusing on those with significant ICT knowledge and income levels. The sampling approach aimed to ensure a representative portion of the university's population, with specific percentages used to select respondents based on the overall population size.

Table 1 Distribution of the sample size

SCHOOLS	SAMPLE	
Modibbo Adama University, Yola	100 L	100
	200 L	90
	300 L	80
		270
	Lecturers	30
TOTAL	300	

Furthermore, the selected university for this study exhibited characteristics similar to other institutions, ensuring a homogenous population regarding the attributes being investigated. To collect data, the researcher employed a questionnaire designed to address specific research questions, utilising a four-point modified rating scale ranging from "Strongly Agreed" (4 points) to "Strongly Disagreed" (1 point). The validity of the questionnaire was established through expert review from the measurement and evaluation department at Modibbo Adama University, who scrutinised the instrument for clarity and appropriateness. Reliability was assessed using the Likert scale method to ensure internal consistency based on responses from both students and lecturers. The researcher personally administered the questionnaire, allowing for clarification of the research purpose and immediate collection of completed forms. Data analysis involved calculating mean scores, with a cutoff mean of 2.5; scores equal to or above this threshold were considered agreeable, while those below were deemed disagreeable.

4. Results

This paper presents an analysis of data collected through questionnaires and key informant interviews conducted with respondents in the study area. The analysis and interpretation are based on the study's findings, with data represented using simple frequency and percentage distributions. Out of 155 questionnaires distributed, 153 were returned and validated for analysis, as two were excluded due to irregular, incomplete, or inappropriate responses. Thus, a total of 153 responses were used in the final analysis.

Table 2 Demographic profile of the respondents

Demographic information	Frequency	percent
Gender		
Male	92	60.1%
Female	61	39.9%
Age		
Under 25	104	67.10%
25-35	39	25.9%
35-Above	10	6.9%
Marital Status		
Single	120	83.1%
Married	30	12.9%
Separated	0	0%
Widowed	3	3.9%
Education Level		
WAEC	00	0%
BS.c	137	89.5%

MS.c	11	7.2%
MBA	5	3.3%

Source: Field Survey, 2024

Table 3 How would you rate the effectiveness of current personal records management systems in Nigeria?

Response	Frequency	Percentage %
Very Effective	62	40%
Effective	50	32.5
Neutral	20	13.0
Ineffective	14	9
Very effective	9	5.5
Total	153	100%

Source: field survey, 2024

In Table 3, it indicates that 62 respondent representing 40.5% Very Effective, 50 respondent representing 32.5% Effective, 20 respondent representing 13.0% neutral, 14 respondent representing 13.0% Ineffective, while 9 respondent representing 5.5% Very effective.

Table 4 What are the major challenges you have experienced with personal records management in Nigeria?

Response	Frequency	Percentage %
Poor data security	40	26.1%
Lack of accessibility	60	39.6%
Inaccurate or outdated records	25	16.3%
High costs of maintenance	19	12.4%
Inefficient processes	9	5.6%
Other	0	0%
Total	153	100%

Source: Field work, 2024

In Table 4 indicates that 40 respondents representing 26.1% Poor data security, 60 respondent representing 39.6% Lack of accessibility, 25 respondents representing 16.3% Inaccurate or outdated records, 9 respondents representing 5.6% Inefficient processes, while 0 respondent representing 0% other.

Table 5 Have you experienced any issues with the privacy of your personal records?

Response	Frequency	Percentage %
Yes	80	52.3%
No	73	47.7%
Total	153	100

Source: Field work, 2024

Table 5 shows that out of the total respondents, 80 individuals, representing 52.3%, responded "Yes" to the question posed, indicating a majority in favor of or agreeing with the statement or issue in question. In contrast, 73 respondents, accounting for 47.7%, responded "No," reflecting a slightly smaller proportion who either disagreed or did not support the statement. The close percentages suggest a relatively balanced distribution of opinions among the respondents, with a slight majority leaning towards a positive or affirmative response.

Table 6 To what extent do you trust the current system to protect your personal records?

Response	Frequency	Percentage
Completely Trust	53	34.6%
Somewhat Trust	68	44.4%
Neutral	16	10.7%
Somewhat Distrust	11	7.1
Completely Distrust	5	3.2%
Total	153	100%

Source: field work, 2024

Table 6 presents the levels of trust among respondents regarding the subject in question. It indicates that 53 respondents, representing 34.6%, expressed complete trust, demonstrating a strong level of confidence in the issue being surveyed. A larger portion, 68 respondents (44.4%), somewhat trust the matter, suggesting a moderate level of confidence with some reservations. Meanwhile, 16 respondents, or 10.7%, remained neutral, neither expressing trust nor distrust, reflecting an indifferent or undecided stance. On the opposite side, 11 respondents, representing 7.1%, somewhat distrust the issue, showing slight skepticism or doubt, while a smaller group of 5 respondents (3.2%) expressed complete distrust, indicating a strong lack of confidence. This distribution highlights a predominantly positive level of trust, with the majority either fully or somewhat trusting the matter, although a small minority harbors varying degrees of distrust or neutrality.

4.1 Blockchain Technology and Personal Records Management

Table 7 Are you familiar with blockchain technology?

Response	Frequency	Percentage%
Yes	90	58.82
No	60	39.22
Unsure	3	1.96
Total	153	100

Source: Field work, 2024

Table 7 reveals the distribution of responses to a particular question, showing that the majority of respondents, 90 individuals (58.82%), answered "yes," indicating strong support or agreement with the statement or issue being addressed. This suggests that a significant portion of the respondents align positively with the topic under consideration. On the other hand, 60 respondents, representing 39.22%, answered "no," reflecting a considerable proportion of participants who either disagree with or do not support the issue. Although this group is smaller than those who said "yes," it still represents a significant minority, indicating some division of opinion among the respondents. Additionally, 3 respondents, or 1.96%, were "unsure," indicating they were either undecided or lacked sufficient information to form a definite opinion. While this is a small percentage, it reflects a portion of the population that may require further clarification or engagement on the matter. Overall, the data shows a clear majority in favor, with a substantial minority opposed and a very small group remaining undecided.

Table 8 In your opinion, how could blockchain technology address the challenges of personal records management in Nigeria?

Response	Frequency	Percentage
Enhanced data security	58	37.9%
Improved transparency and traceability	40	26.1%
Reduced costs	23	15.8%
Increased accessibility	19	12.4%
Reduced errors and fraud	10	6.5%
Other	2	1.3%
Total	153	100%

Source: Field work, 2024

Table 8 illustrates the distribution of respondents' views on the primary benefits they associate with a particular system or technology. The largest group, comprising 58 respondents (37.9%), identified "Enhanced data security" as the most significant benefit, highlighting the importance of protecting sensitive information and preventing data breaches as a key priority for a substantial portion of participants. Following this, 40 respondents (26.1%) selected "Improved transparency and traceability," indicating that a notable number of individuals value the system's ability to provide clearer, more accessible records and accountability in processes. This suggests that for over a quarter of the respondents, being able to track data and activities with greater clarity is a major advantage. A smaller but significant group of 23 respondents (15.8%) chose "Reduced costs," reflecting the appeal of financial efficiency and cost savings as a key benefit. For these respondents, the system's ability to streamline processes and reduce expenses is a critical factor.

Additionally, 19 respondents (12.4%) pointed to "Increased accessibility," emphasizing the importance of making data or services more easily accessible to users. This suggests that a portion of respondents prioritize ease of access and availability in their assessment of the system's advantages. Only 10 respondents (6.5%) highlighted "Reduced errors and fraud," indicating that, while important, fewer participants viewed this as the primary benefit compared to other advantages. Finally, 2 respondents (1.3%) selected "Other," signifying that a very small percentage identified benefits not explicitly listed in the table, possibly reflecting unique or specific perspectives on the technology's value. Largely, the data shows that respondents prioritize enhanced security and transparency, with cost reduction, accessibility, and error reduction being secondary, yet still important, considerations.

Table 9 What potential impact do you think blockchain adoption could have on individuals in Nigeria regarding personal records management?

Response	Frequency	Percentage%
Improved privacy and security	40	26.9%
Greater control over personal data	55	35.9%
Easier access to records	35	22.8%
Increased confidence in the accuracy of records	22	14.4%
Other	0	0%

Total	153	100%
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Source: Field work, 2024

From the responses obtained as expressed in Table 9, 40 respondents representing 26.9% Improved privacy and security, 55 respondents representing 35.9% Greater control over personal data, 35 respondent representing 22.8% Easier access to records, 22 respondents representing 14.4% Increased confidence in the accuracy of records, while the remaining 0 respondent representing 0% other.

Table 10 What concerns, if any, do you have about the adoption of blockchain technology for personal records management?

Response	Frequency	Percentage%
Lack of understanding of blockchain	17	11.5%
High implementation costs	25	16.7%
Resistance to change	56	36.6%
Privacy concerns	34	22.2%
Legal and regulatory challenges	20	13.0%
Other	0	0%
Total	153	100%

Source: Field work, 2024

From the responses obtained as expressed in Table 10, 17 respondentst representing 11.5% Lack of understanding of blockchain, 25 respondents representing 16.7% High implementation costs, 56 respondents representing 36.6% Resistance to change, 34 respondents representing 22.2% Privacy concerns, 20 respondents representing 13.0% Legal and regulatory challenges, while the remaining 0 respondent representing 0% were partially.

4.2 Barriers to Blockchain Adoption

Table 11 What do you believe are the main barriers to adopting blockchain technology for personal records management in Nigeria?

	Frequency	Percentage%
Lack of technical expertise	37	24.4%
High initial costs	30	19.6%
Limited awareness of blockchain benefits	25	16.3%
Resistance from stakeholders	35	22.8%
Uncertain regulatory environment	10	6.5%
Lack of infrastructure	16	10.4%
Other	0	

Total	153	100%
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Source: Field work, 2024

Table 11 indicates that 37 respondents representing 24.4% Lack of technical expertise, 80 respondent representing 26.7% High initial costs, 30 respondent representing 19.6% Limited awareness of blockchain benefits, 25 respondents representing 16.3% Resistance from stakeholders, 35 respondent representing 22.8% Lack of infrastructure, 10 respondent representing 6.5%, while 0 respondent representing 0% Other.

Table 12 What measures do you think could facilitate the adoption of blockchain technology for personal records management in Nigeria?

Response	Frequency	Percentage
Government incentives and support	53	34.6%
Public awareness campaigns	32	20.9%
Training and capacity building	25	16.6%
Development of supportive legal frameworks	13	8.4
Partnership with technology firms	26	16.9
Other	4	2.6
Total	153	100%

Source: Field work, 2024

Table 12 indicates that 53 respondents representing 34.6% Government incentives and support, 32 respondents representing 20.9% Public awareness campaigns, 25 respondent representing 16.6% Training and capacity building, 13 respondents representing 8.4% Development of supportive legal frameworks, 26 respondent representing 16.9% Partnership with technology firms, while 4 respondents representing 2.6% other.

Table 13 Would you be willing to adopt blockchain technology for managing your personal records if its benefits were proven?

Response	Frequency	Percentage%
Yes	102	66.6%
No	51	33.4%
Total	153	100%

Source: Field work, 2024

The responses displayed in Table 13 indicate that a substantial majority of 102 respondents, representing 66.6%, answered "yes" to the question posed, signifying strong support, agreement, or approval for the issue under discussion. This majority response suggests that two-thirds of the participants hold a favorable or positive view on the matter, demonstrating a clear consensus within the group. In contrast, 51 respondents, accounting for 33.4%, answered "no," indicating disagreement or disapproval. While this is a smaller portion of the total respondents, it still represents a

significant minority, showing that over one-third of the participants are either opposed to or do not share the majority's stance. The notable size of this group suggests that although the majority is in favor, there is still a considerable divergence of opinion among the respondents, highlighting the need to understand the reasons behind the differing viewpoints. This distribution of responses, with two-thirds in agreement and one-third in opposition, points to a prevailing consensus but also underscores the importance of considering the concerns or hesitations of the minority group in any subsequent decision-making or analysis.

5. Discussion

The current personal records management systems in Nigeria face significant challenges, primarily in terms of poor data security, lack of accessibility, and inefficient processes. These issues result in outdated, inaccurate records and high maintenance costs, reflecting the inadequacy of traditional systems to meet modern demands. The analysis suggests that the root causes of these challenges include insufficient investment in technology, outdated infrastructure, and inadequate training for personnel. The widespread concerns about data security underscore the urgent need for secure and efficient systems capable of handling the complexities of managing personal records in a large, diverse country like Nigeria. Blockchain technology is seen as a promising solution to these issues, with respondents highlighting its potential to enhance data security, improve transparency, and reduce costs. The technology's decentralised and immutable nature offers a reliable alternative to the current system, allowing for greater accessibility, reduced risk of fraud, and a more efficient management process. However, despite the perceived benefits, barriers such as a lack of technical expertise, high implementation costs, and resistance to change could hinder the adoption of blockchain. Overcoming these challenges will require strategic investment in infrastructure, education, regulatory support, and public awareness campaigns to ensure a smooth transition to blockchain-based systems.

6. Conclusion

This paper examined the potential of blockchain technology to improve the security and accessibility of personal records in Nigeria. The findings highlight blockchain's significant advantages over traditional record management systems, particularly in terms of data integrity, encryption, and decentralised access. Blockchain's immutable ledger and cryptographic techniques offer robust protection against data breaches, while decentralisation streamlines record retrieval, minimizing delays and system fragmentation. Despite these benefits, several challenges hinder its adoption in Nigeria, including inadequate technological infrastructure, regulatory uncertainties, and low public awareness of blockchain technology. Furthermore, the article concludes that blockchain could revolutionise personal records management in Nigeria, aligning with global trends of enhanced transparency and efficiency in data handling. However, successful implementation will depend on overcoming major obstacles, such as improving technological readiness, establishing clear regulatory frameworks, and promoting public understanding. Strategic measures such as investing in infrastructure, creating regulations, raising awareness, and launching pilot projects are recommended to address these challenges. A collaborative, multi-stakeholder approach will be essential for realizing the full potential of blockchain in securing and managing personal records.

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