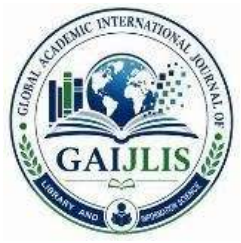
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# BLOCKCHAIN TECHNOLOGY FOR LIBRARY RECORDS MANAGEMENT: FEASIBILITY AND SECURITY IMPLICATIONS FOR NIGERIAN ACADEMIC LIBRARIES

**[1]OLAWEPO, Saheed Adesina (PhD, CLN) [2]ADOMA, Favour E. (CLN) [3]ALHAJI Muntari Mato, CLN.**

[1]Federal College of Education, Abeokuta, Ogun State olawepo7158@gmail.com., [2]Kenule Beeson Polytechnic, Bori, Rivers State, adomafavour@gmail.com, [3]Jamilu Ibrahim Imperial College of Health Sciences and Technology (JICOHSAT) mmalhaji59@gmail.com

## *Abstract*

This article examined blockchain technology for library records management, with particular attention to its feasibility and security implications for Nigerian academic libraries. Four objectives guided the study. The objectives examined potential applications of blockchain in library records management, security implications, feasibility of adoption and institutional challenges associated with implementation. The conceptual review examined blockchain technology, library records management, feasibility and information security. The theoretical review discussed applications in library records management, security and integrity, feasibility in Nigerian academic libraries, adoption challenges, governance and professional competencies. The Technology Organization Environment framework provided the theoretical foundation. A qualitative documentary research design was adopted, while content analysis was used to examine relevant scholarly publications on blockchain, records management and academic libraries. The findings showed that blockchain could support circulation, metadata management, digital preservation, institutional repositories, digital rights management and scholarly communication. The analysis also showed that blockchain could strengthen record integrity, authentication and traceability, but could not replace broader security and privacy measures. Adoption was found to be feasible where adequate infrastructure, funding, policy support and technical competence existed. The study concluded that blockchain should be introduced gradually through carefully selected library applications. It recommended pilot projects, staff training, policy development, infrastructure improvement and cooperation between libraries, ICT units and university management.

**Keyword:** Blockchain technology, Library records management, Feasibility implications, Security implications Nigerian academic libraries

## Introduction

Academic libraries in Nigeria are increasingly moving from predominantly physical record keeping to digital systems that support cataloguing, circulation, institutional repositories, electronic resource management and user services. This transition has improved the speed of information retrieval and expanded access to library resources, but it has also increased concerns about the integrity, security and

authenticity of electronic records. Blockchain technology has emerged as a distributed record keeping technology capable of creating verifiable and traceable transactions without relying entirely on a single central authority. Yli Huumo et al. (2016) explained that blockchain provides important properties such as data integrity, security and transparency, although scalability and technical limitations remain concerns. Bhatia et al. (2020) similarly observed that blockchain can provide independent verification and authentication of digital records. These characteristics make the technology relevant to academic libraries where reliable records are essential for circulation, digital preservation, scholarly communication and institutional repositories.

The relevance of blockchain to libraries extends beyond the protection of ordinary transaction records. Library systems generate records relating to acquisition, cataloguing, borrowing, returns, electronic access, institutional repository deposits, copyright and digital rights management. Jha (2023) noted that blockchain can support the protection of library user records, digital resources, collection management and scholarly communication. Oyelude (2022) also identified applications of blockchain in libraries, archives and museums that include collection management, intellectual property management and protection against unauthorized alteration of institutional data. In Nigeria, the growing interest in blockchain is particularly relevant because academic libraries operate within environments where inadequate infrastructure, unstable power supply, limited technical expertise and financial constraints can influence the adoption of emerging technologies. Ojobor (2023) found that Nigerian federal university libraries could apply blockchain to metadata management, peer to peer resource sharing and digital rights management, while also facing challenges associated with funding, connectivity, power supply and technical competence.

The feasibility of blockchain adoption therefore requires consideration of more than its technical capabilities. Academic libraries must determine whether the technology can be integrated with existing integrated library systems, institutional repositories, authentication arrangements and university information infrastructure. Akintunde and Amuda (2024) found that perceived usefulness and institutional policy were important factors influencing blockchain adoption intentions among academic libraries in Nigeria. Kayode and Oguntayo (2024) similarly reported that system librarians in Nigerian academic libraries perceived blockchain positively because of its potential for creating verifiable and distributed records, although they identified

installation, scalability, maintenance, integration, governance and data protection as important challenges. These findings suggest that blockchain may provide useful opportunities for improving records management, but its practical value will depend on institutional readiness, appropriate governance, technical capacity and careful assessment of security requirements.

## Statement of the Problem

Ideally, Nigerian academic libraries should maintain accurate, authentic, secure and easily verifiable records that can support circulation, digital preservation, institutional repositories, scholarly communication and administrative decision making. Blockchain technology offers features that could strengthen these functions through distributed recording, transaction traceability and protection against unauthorized alteration. However, many university libraries continue to depend mainly on conventional centralized systems, while knowledge about practical blockchain applications remains developing. Limited technical expertise, inadequate infrastructure, financial constraints, interoperability concerns, governance questions and uncertainty about data protection may restrict adoption. Bhatia et al. (2020) noted that blockchain introduces important changes to established approaches to records management, while Ojobor (2023) identified funding, connectivity, power supply and personnel competence as barriers in Nigerian university libraries. Existing Nigerian studies have examined awareness and adoption, but fewer studies have brought feasibility, records management and security implications together. This gap provides justification for examining blockchain as a possible approach to library records management in Nigerian academic libraries.

## Objectives of the Study

The study was guided by four objectives:

1. To examine the potential applications of blockchain technology for library records management in Nigerian academic libraries.
2. To examine the security implications of blockchain technology for the management of library records.
3. To assess the feasibility of adopting blockchain technology in Nigerian academic libraries.
4. To identify the major challenges and institutional requirements associated with blockchain adoption for library records management.

## Concept of Blockchain Technology

Blockchain technology refers to a distributed system for recording transactions and

information across a network in which records are linked and protected against unauthorized alteration. Rather than depending completely on a single central database, blockchain distributes copies of records among participating nodes and uses agreed procedures for validating transactions. Yli Huumo et al. (2016) described blockchain as a decentralized transaction and data management technology whose major areas of interest include security, privacy, integrity and scalability. Bhatia et al. (2020) explained that the technology can provide independent verification and authentication of digital records. In library environments, these characteristics can support reliable transaction histories and verifiable records. Blockchain should not, however, be regarded as a solution to every information management problem because its implementation introduces questions concerning cost, interoperability, governance, privacy, technical competence and long term maintenance.

## Library Records Management

Library records management involves the creation, organization, maintenance, preservation, retrieval and appropriate disposal of records generated through library activities. Such records may include acquisition records, bibliographic records, circulation transactions, membership information, electronic resource usage records, institutional repository records and digital preservation information. Bhatia et al. (2020) observed that records managers must consider authenticity, veracity, trustworthiness and disposition when applying blockchain to records management. Jha (2023) further indicated that blockchain could support library collection management, user records, digital rights management and scholarly communication. In Nigerian academic libraries, effective records management is particularly important because digital library systems increasingly support teaching, learning and research. Blockchain may therefore complement existing records management systems by providing additional mechanisms for transaction verification and traceability, provided that its application is carefully designed around actual library requirements.

## Feasibility of Blockchain in Academic Libraries

Feasibility refers to the practicality of introducing and sustaining blockchain within the technical, financial, organizational and professional environment of an academic library. It involves assessing infrastructure, technical skills, institutional support, policies, costs, interoperability, user acceptance and expected benefits. Akintunde and Amuda (2024) found that perceived usefulness and

institutional policy were important considerations in blockchain adoption among academic libraries in Nigeria. Kayode and Oguntayo (2024) also found positive perceptions among Nigerian system librarians but identified installation difficulty, scalability, maintenance costs, integration and governance as challenges. Feasibility should therefore be determined through a careful examination of institutional capacity rather than simply through enthusiasm about the technology. A library may recognize the advantages of blockchain while still lacking the infrastructure, expertise and financial resources required for sustainable implementation.

## Security Implications of Blockchain

Security is one of the principal reasons blockchain has attracted attention in records management. Blockchain can strengthen data integrity because validated records are difficult to alter without detection by participating nodes. Yli Huumo et al. (2016) identified security and data integrity as important characteristics of blockchain, while Bhatia et al. (2020) explained that properly implemented blockchain can support immutable recording, verification and authentication of digital records. For libraries, this may be useful for circulation records, institutional repository transactions, digital rights management and evidence of record ownership. However, blockchain does not automatically eliminate every security problem. Access credentials, connected applications, external storage, governance arrangements and system administration can still create vulnerabilities. Security assessment must therefore consider the entire library information environment rather than treating blockchain itself as a complete security solution.

## Blockchain Applications in Library Records Management

Blockchain has potential applications across several areas of library records management. One important application is circulation management because transactions involving borrowing, renewal and return can be recorded in a traceable manner. Another application is digital preservation, where blockchain can provide evidence that a digital object or metadata record existed in a particular form at a particular time. Jha (2023) identified collection management, user records, digital rights management and scholarly communication as possible areas of blockchain application in libraries. Ojobor (2023) similarly reported potential uses in Nigerian federal university libraries, including enhanced metadata systems, peer to peer sharing and digital rights management. Blockchain can also support institutional repositories by providing verifiable records of

deposits and changes to repository information. Its value therefore lies mainly in strengthening trust, traceability and verification rather than simply replacing existing library management systems.

**Table 1: Potential Applications of Blockchain in Academic Library Records Management**

| Library activity | Possible blockchain application | Expected benefit |
|---|---|---|
| Acquisition | Recording acquisition transactions | Traceability and accountability |
| Cataloguing | Verification of metadata records | Record integrity |
| Circulation | Recording borrowing and return transactions | Transparent transaction history |
| Institutional repositories | Verification of deposits and record changes | Authenticity and traceability |
| Digital preservation | Recording evidence of digital objects | Integrity and provenance |
| Digital rights management | Recording ownership and rights transactions | Rights verification |
| Interlibrary cooperation | Recording resource sharing transactions | Greater accountability |
| Scholarly communication | Time stamping scholarly contributions | Evidence of authorship and priority |

## Security and Integrity of Library Records

The security implications of blockchain are particularly important because academic libraries manage records that may have administrative, intellectual and personal value. A blockchain based system can make unauthorized alteration more difficult by distributing records across participating nodes and maintaining a history of validated transactions. Bhatia et al. (2020) argued that blockchain can provide independent verification and authentication of digital records, while Oyelude (2022) identified protection against data tampering as an important opportunity for libraries and other memory institutions. Security benefits may therefore include improved integrity, transaction traceability, authentication and accountability. Nevertheless, libraries must distinguish between protecting the integrity of a record and protecting the confidentiality of information contained within it. Sensitive personal information should not automatically be placed on a distributed ledger. Proper access controls, encryption, privacy arrangements and data governance remain necessary.

**Table 2: Security Benefits and Associated Concerns**

| Security area | Possible benefit of blockchain | Associated concern |
|---|---|---|
| Data integrity | Reduced unauthorized alteration | Incorrect information may remain permanently recorded |
| Authentication | Verifiable transaction history | Compromised credentials can create security risks |
| Accountability | Traceable transactions | Excessive monitoring may affect privacy |
| Record provenance | Evidence of record history | Technical complexity may affect management |
| Access control | Controlled participation in a network | Poor configuration can expose information |
| Digital rights | Traceable ownership information | Legal and policy requirements must be addressed |
| Preservation | Evidence of record authenticity | Long term technological sustainability remains uncertain |

**Feasibility of Blockchain Adoption in Nigerian Academic Libraries**

Evidence from Nigerian academic libraries suggests that blockchain adoption is feasible in principle but requires significant institutional preparation. Akintunde and Amuda (2024) examined blockchain adoption in Nigerian academic libraries using an integrated Technology Acceptance Model and Technology Organization and Environment framework. Their findings indicated that perceived usefulness and institutional policy were important factors in adoption intentions. Kayode and Oguntayo (2024) found that system librarians in Nigerian academic libraries were aware of blockchain and viewed its potential positively, particularly for distributed management of digital archives. However, the same study identified installation, scalability, maintenance cost, integration, data protection, governance and technical issues as barriers. These findings suggest that feasibility should be approached through gradual implementation, pilot projects and institutional assessment rather than immediate large scale deployment.

The preparedness of librarians is also relevant because emerging technology requires changes in professional knowledge and practice. In a study of information and communication technology tools among library educators in tertiary institutions in Anambra State, Uzoagba et al. (2024) demonstrated the continuing importance of technological capacity in library education and practice. The implication for blockchain

adoption is that librarians need opportunities to understand distributed records, data security, digital preservation and emerging information technologies before being expected to participate effectively in implementation. Technical expertise should also extend beyond librarians to include ICT personnel and university administrators. A feasible blockchain initiative would therefore require cooperation among the library, ICT unit, university management and relevant data governance personnel.

### Challenges to Blockchain Adoption

The adoption of blockchain may be constrained by infrastructure, cost, technical complexity, interoperability and professional competence. Ojobor (2023) identified inadequate funding, irregular electricity supply, poor broadband connectivity and shortages of competent personnel among challenges affecting blockchain adoption in Nigerian federal university libraries. Kayode and Oguntayo (2024) similarly identified installation difficulty, scalability, maintenance costs, integration, governance, data protection and sustainability as concerns. These challenges are important because blockchain systems require reliable computing infrastructure and appropriate technical administration. Libraries also need to consider whether existing integrated library systems can communicate effectively with a blockchain network. In addition, institutions must determine who will operate participating nodes, who will authorize transactions and how errors or inappropriate records will be handled.

The professional environment also requires attention. Libraries adopting new technologies need staff who can understand both the opportunities and limitations of those technologies. Agim et al. (2024) reported that library innovation initiatives in Nigerian public libraries were associated with issues involving funding, staff training, administrative support and equipment maintenance. Although the study focused on makerspaces rather than blockchain, its findings demonstrate the broader organizational requirements that accompany technological innovation in Nigerian libraries. Blockchain adoption should therefore be supported by staff training, technical assistance, management commitment and continuous evaluation. The technology should be introduced where it addresses an identifiable records management need and where the institution has the capacity to maintain it.

### Governance, Privacy and Ethical Considerations

Blockchain adoption in academic libraries raises governance and ethical questions because library records may contain

information about users, research interests and institutional activities. The distributed character of blockchain can make the correction or removal of information more complicated than in conventional databases. This creates a need for clear policies governing what information should be placed on the blockchain and what information should remain in controlled databases. Jha (2023) emphasized the potential of blockchain to protect user and research data, but effective protection depends on appropriate implementation. Bhatia et al. (2020) also stressed that recordkeeping requirements should be considered before blockchain applications are developed. Nigerian universities should therefore establish clear rules covering data ownership, access privileges, retention, privacy, responsibility and system governance before implementing blockchain for library records.

## Emerging Competencies for Librarians

Blockchain adoption will require librarians to develop knowledge that extends beyond conventional library management. Relevant competencies include understanding distributed ledger concepts, digital preservation, authentication, data security, privacy, metadata, digital rights and basic blockchain governance. Shahzad et al. (2024) found that blockchain could positively affect university librarians by supporting digital resource management, integrated library services, records management and professional development. Librarians therefore need sufficient knowledge to participate in decisions about whether blockchain is appropriate for particular library functions. They do not necessarily need to become blockchain programmers, but they should understand how the technology works, what information it can protect, what risks it introduces and how it interacts with existing systems. This professional preparation is necessary if libraries are to make informed rather than technology driven decisions.

## Theoretical Framework: Technology Organization Environment Framework

The Technology Organization Environment framework was developed by Tornatzky and Fleischer (1990) to explain how organizations adopt technological innovations. The framework proposes that technology adoption is influenced by three broad contexts: the characteristics of the technology, the characteristics of the organization and the surrounding environmental conditions. Its central assumption is that adoption decisions are not determined by technological advantages alone. An organization considers the benefits, complexity and compatibility of a technology, its internal resources and

capabilities, as well as external pressures, regulations and institutional relationships. The framework aims to explain why organizations differ in their willingness and capacity to adopt new technologies. In the present study, the technological context relates to blockchain security, compatibility and complexity; the organizational context relates to funding, staff competence, infrastructure and management support; while the environmental context includes university policy, legal requirements, vendors and broader developments in Nigerian higher education. Recent research by Akintunde and Amuda (2024) demonstrates the usefulness of the Technology Organization Environment perspective for examining blockchain adoption in Nigerian academic libraries.

## Methodology

The study adopted a qualitative documentary research design using content analysis. Relevant scholarly publications on blockchain technology, library records management, academic libraries, information security and blockchain adoption were purposively identified from recognized journal platforms, institutional repositories and academic databases. Priority was given to peer reviewed publications published from 2015 onward, while foundational theoretical literature was retained where necessary for explaining the Technology Organization Environment framework. The selected literature was examined according to the four objectives of the study. Information relating to blockchain applications in library records management, security implications, feasibility and adoption challenges was extracted and organized into thematic categories. Findings were compared across studies to identify areas of agreement, differences and recurring concerns. Particular attention was given to studies conducted in Nigeria because the purpose was to determine the practical implications of blockchain adoption within the Nigerian academic library environment. The analysis did not treat blockchain as automatically beneficial; instead, evidence concerning both opportunities and limitations was considered before drawing conclusions.

## Content Analysis of Findings

### Applications of Blockchain Technology for Library Records Management

The content analysis showed that blockchain has several potential applications in academic library records management. The most frequently discussed applications were transaction recording, digital preservation, metadata verification, institutional repository management, digital rights management, circulation and scholarly communication. Ojobor (2023) identified enhanced metadata

management, peer to peer sharing and digital rights management as important possibilities in Nigerian university libraries, while Jha (2023) reported applications involving user records, collection management, scholarly communication and protection of digital resources. Kayode and Oguntayo (2024) further found that Nigerian system librarians perceived blockchain as useful for collecting, preserving and disseminating authoritative information in a distributed environment. The finding indicates that blockchain has relevance to several library record functions, although its application should be determined by specific institutional needs rather than by technology adoption alone.

### Security Implications of Blockchain Technology

The analysis established that blockchain can strengthen important aspects of library records security, particularly data integrity, authentication, provenance and transaction traceability. Bhatia et al. (2020) found that properly implemented blockchain can provide immutable recording, independent verification and authentication of digital records. Oyelude (2022) similarly reported that blockchain can help memory institutions protect records from unauthorized alteration and support the management of intellectual property information. However, the analysis also showed that blockchain does not eliminate all security concerns. Privacy, credential management, system configuration, governance and the treatment of sensitive information remain important issues. Jha (2023) emphasized both the security potential of blockchain and the need for libraries to understand its risks before implementation. The finding therefore indicates that blockchain should be regarded as one component of a broader information security strategy.

### Feasibility of Blockchain Adoption in Nigerian Academic Libraries

The analysis indicated that blockchain adoption is technically and organizationally possible in Nigerian academic libraries, but its feasibility depends on institutional readiness. Akintunde and Amuda (2024) found that perceived usefulness and institutional policy influenced blockchain adoption intentions among Nigerian academic libraries. Kayode and Oguntayo (2024) reported positive perceptions among system librarians but also identified installation difficulties, scalability, maintenance costs, integration, data protection and governance as barriers. Ojobor (2023) further identified funding limitations, irregular electricity supply, poor broadband connectivity and inadequate technical competence as challenges in Nigerian federal university libraries. The evidence suggests that feasibility should be

vassessed institution by institution. Libraries with stronger ICT infrastructure, management support, technical personnel and clear policies may be better positioned to conduct controlled pilot projects than institutions with limited technological capacity.

### Challenges and Institutional Requirements for Blockchain Adoption

The analysis revealed that the principal challenges are inadequate funding, unreliable infrastructure, limited technical competence, system integration, maintenance, governance, privacy and uncertainty about long term sustainability. Ojobor (2023) reported similar concerns among Nigerian federal university libraries, particularly inadequate funding, poor connectivity, irregular power supply and shortage of competent personnel. Shahzad et al. (2024) also identified challenges associated with blockchain adoption in university libraries while emphasizing its potential contribution to records management and digital services. Evidence from Nigerian library innovation research further indicates that technological initiatives require staff training, management support and equipment maintenance. Agim et al. (2024) found that funding, staff training, administrative support and equipment maintenance were important issues affecting library innovation. The combined evidence indicates that blockchain implementation requires institutional preparation rather than the simple acquisition of a technological platform.

### Discussion of Findings

The finding that blockchain has several applications in library records management agrees with previous empirical and scholarly work. Ojobor (2023) found that Nigerian federal university libraries could apply blockchain to enhanced metadata systems, peer to peer sharing and digital rights management. Similarly, Kayode and Oguntayo (2024) reported that system librarians in Nigerian academic libraries perceived blockchain as useful for collecting, preserving and disseminating authoritative information through distributed records. Jha (2023) also identified user records, collection management, digital rights management and scholarly communication as potential areas of application. The agreement among these studies suggests that blockchain has relevance to library records beyond circulation transactions. Its most promising contribution appears to be the creation of verifiable records and improved traceability across activities in which authenticity and accountability are important.

The finding that blockchain can strengthen library records security is supported by Bhatia et al. (2020), who explained that

blockchain can provide independent verification and authentication of digital records while making unauthorized alteration more difficult. Oyelude (2022) similarly identified protection against data tampering as one of the emerging applications of blockchain in libraries, archives and museums. Jha (2023) further reported that blockchain can contribute to the protection of library user records and research data. These studies support the view that blockchain can improve the integrity and traceability of library records. However, the present analysis also emphasizes that security cannot be reduced to blockchain alone. Privacy, authentication credentials, access management and institutional governance remain important because weaknesses in connected systems can still expose library information even when blockchain records themselves are difficult to alter.

The finding concerning the feasibility of blockchain adoption is consistent with evidence from Nigerian academic libraries. Akintunde and Amuda (2024) found that perceived usefulness and institutional policy were important factors influencing blockchain adoption intentions among academic libraries in Nigeria. Kayode and Oguntayo (2024) also found positive perceptions among Nigerian system librarians and identified potential benefits for digital archive management. However, both studies also reported important implementation concerns. Ojobor (2023) found that funding, power supply, broadband connectivity and technical competence could constrain blockchain adoption in Nigerian federal university libraries. The evidence therefore supports a conditional interpretation of feasibility. Blockchain adoption appears possible, but institutional readiness, technical infrastructure, policy support and professional competence are necessary conditions for successful implementation.

The finding that blockchain adoption requires institutional preparation agrees with several studies. Ojobor (2023) identified funding, inadequate infrastructure, poor broadband connectivity, irregular power supply and shortage of competent personnel as important challenges in Nigerian university libraries. Shahzad et al. (2024) also identified adoption challenges while reporting that blockchain could assist university librarians with digital resource management, records management and professional development. In a related Nigerian study of library innovation, Agim et al. (2024) identified funding, staff training, administrative support and equipment maintenance as challenges affecting the implementation of innovative library services. Although the latter study did not focus on blockchain, its findings are relevant because blockchain represents

another technological innovation requiring institutional resources and professional competence. The evidence therefore suggests that Nigerian universities should approach blockchain through carefully planned implementation rather than isolated technological experimentation.

## Conclusion

Blockchain technology presents a potentially useful approach to improving the integrity, authenticity and traceability of records in Nigerian academic libraries. The literature reviewed indicates that it can support circulation, metadata management, digital preservation, institutional repositories, digital rights management and scholarly communication. Its security benefits are associated mainly with verification and protection against unauthorized alteration, while its feasibility depends on infrastructure, technical competence, institutional policy, funding and management support. The evidence also shows that blockchain introduces new governance and privacy questions that libraries must address before implementation. Nigerian academic libraries should therefore consider blockchain through carefully planned pilot initiatives that are based on clearly identified records management needs. Successful adoption will depend on cooperation among librarians, ICT personnel, university administrators and other stakeholders responsible for information governance.

## Recommendations

1. Nigerian university libraries should begin with controlled pilot projects in specific areas such as institutional repository records, digital preservation or circulation transactions before considering wider implementation.
2. University management should provide continuous training for librarians and ICT personnel on blockchain concepts, information security, digital preservation, data governance and digital rights management.
3. Libraries should develop clear policies addressing blockchain governance, data ownership, access control, privacy, record retention, system responsibility and procedures for correcting erroneous information.
4. University libraries should strengthen ICT infrastructure, internet connectivity, power reliability and technical support before deploying blockchain systems on a large scale.
5. Libraries should establish collaborative implementation teams involving library management, ICT units, university administrators and relevant data protection personnel to

assess costs, interoperability, security and long term sustainability.

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