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Exploring the Enablers for the Adoption of Blockchain in Nigerian Academic Libraries

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ABSTRACT

This research investigates the elements that affect the adoption of blockchain technology in academic libraries in Nigeria, utilizing the Human, Organization, and Technology (HOT) Fit model. It emphasizes prior technology experience, attitudes towards change, support from top management, organizational preparedness, and perceived ease of integration and compatibility. Employing a quantitative methodology, data were gathered through structured surveys given to librarians, with relationships examined using structural equation modeling (SEM). The results indicate significant influences of prior technology experience ($\beta = 0.32$, $p < 0.001$), attitudes towards change ($\beta = 0.29$, $p < 0.001$), support from top management ($\beta = 0.34$, $p < 0.001$), organizational preparedness ($\beta = 0.27$, $p < 0.001$), and ease of integration ($\beta = 0.31$, $p < 0.001$) on the adoption of blockchain, while also identifying cost concerns and data security risks as major obstacles. This study broadens the application of the HOT Fit model to a novel context, providing a detailed framework for comprehending blockchain adoption in libraries and delivering actionable insights to enhance technology readiness and service provision. The findings make a valuable contribution to the literature by tackling cultural and infrastructural challenges, paving the way for future research on technology adoption in comparable settings.

1.Introduction

The fourth industrial revolution has paved the way for emerging technologies, and among them, blockchain stands out for its unprecedented ability to create and trade value in library organizations. Facing the challenges of digitization, universities are required to transition from traditional academic processes to digital academic processes. One common issue that frequently arises is the university's inability to manage data, ensure security, and validate every academic process digitally. This incapacity stems from the limitations of the technology used and the lack of integration among the implemented systems. Therefore, the adoption of blockchain technology is crucial to enhance the efficiency, security, and integrity of the systems used by universities. Blockchain, as a disruptive innovation, has already reshaped various industries by providing a secure, transparent way to verify and record transactions . In academic libraries, it could streamline tasks such as interlibrary loans, archiving, and the management of digital collections, making it a valuable tool for handling complex digital rights management (DRM) and authentication issues . Blockchain can also enable more efficient financial transactions and the scholarly publishing process, allowing librarians to manage submissions and vendor payments securely .

Consequently, Blockchain provides reliable method for secure resource sharing in the library ensuring these records are verifiable and immutable. It is able to create secure, transparent and accountable systems which aids in managing digital and physical resources.

However, despite these advantages, the transition to Blockchain-based systems faces multiple barriers. Libraries, especially in developing regions, grapple with limited technological resources, unstable policies, and a lack of documented guidelines for Blockchain implementation. Moreover, financial limitations, the evolving nature of Blockchain, and resistance from library professionals further complicate adoption . Addressing these barriers requires not only technical knowledge but also the commitment of sufficient financial and human resources . Despite the abundance of research on Blockchain applications in areas like finance and healthcare, its use in libraries remains underexplored. This gap in research, coupled with the limited technical expertise among librarians, has slowed the adoption of Blockchain in academic settings. Therefore, this study seeks to bridge this gap by exploring the factors that can enable or inhibit Blockchain adoption in academic libraries, particularly in Nigeria. By identifying these factors, this research aims to contribute to the understanding of Blockchain's transformative potential in academic libraries and provide a roadmap for overcoming the barriers to its adoption.

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Statement of the Problem

Despite the potential of Blockchain to fundamentally transform library systems, its integration is obstructed by numerous impediments, including insufficient technological infrastructure, financial limitations, and the absence of established operational policies. Furthermore, a significant number of librarians lack proficiency in this technology, which intensifies the difficulty of transitioning from conventional systems to those based on Blockchain. In addition, the ongoing advancement of Blockchain, along with its inherent technical intricacies, adds layers of complexity to its adoption within academic libraries.

Consequently, Nigerian academic libraries encounter considerable difficulties in the adoption of Blockchain technology, notwithstanding its capacity to transform library services through secure, decentralized methods for digital rights management, resource sharing, and transactional operations Despite the prominent features of blockchain, blockchain research is still in its infancy. Most research focuses mainly on technical issues . Additionally, the adoption of blockchain technology is slower than its potential. The gap between blockchain's potential and its current adoption has motivated scholars to understand the factors affecting technology adoption. Therefore, more studies are needed to expand the applications by investigating the antecedents of blockchain adoption intention . Therefore, there exists a pressing need for a thorough assessment of the determinants affecting the implementation of Blockchain technology in libraries to surmount these obstacles and fully exploit its capabilities.

Aim and Objectives

This study aims to assess the readiness and determinants influencing the adoption of Blockchain technology in Nigerian academic libraries.

Objectives:

- To evaluate librarians' awareness and understanding of Blockchain technology and its potential applications in library services.
- To assess the readiness and willingness of librarians to adopt Blockchain technology, including their perceived competency and training needs.
- To examine the level of institutional support for Blockchain adoption, including management commitment, financial resources, and strategic planning.
- To identify the interrelationship among human, organizational, and technological elements that collectively influence the overall preparedness of Nigerian academic libraries for the adoption of Blockchain technology

2.Literature Review

This section of the paper delves into various research studies concerning BT, libraries and the H–O–T theory. The discussion revolves around these topics, analyzing their implications and findings.

Blockchain technology has emerged as a transformative force, providing a decentralized and secure framework for the management of digital rights, resource sharing, and transactions within academic libraries. This advancement holds the promise of increasing transparency and operational efficiency in library services. Applications of this technology in libraries encompass enhanced digital rights management (DRM), authentication, access control, interlibrary loans, archiving, and the preservation of digital assets. Blockchain enables the generation of verifiable records, thereby assisting librarians in effectively managing digital rights and combating plagiarism. Additionally, it facilitates financial transactions and optimizes scholarly publishing processes, enabling streamlined manuscript submission and review.

3.Theoretical Framework

The adoption of emerging technologies, including Blockchain, has been widely explored in information systems and computing through established theories such as the Technology Acceptance Model (TAM), Theory of Planned Behaviour (TPB), Theory of Reasoned Action (TRA), Diffusion of Innovation (DOI), and Unified Theory of Acceptance and Use of Technology (UTAUT). These theories focus on individual adoption behaviors and provide valuable insights into how personal beliefs, attitudes, and readiness influence technology uptake. However, Blockchain, as a complex and evolving technology, demands a more comprehensive approach that considers organizational and technological dimensions in addition to human factors.

Another theoretical approach is the IASAM (Integrated Acceptance and Sustainability Assessment Model) framework based on the UTAUT acceptance model, which discusses the evaluation of technology in terms of acceptance and sustainability. Specific roles of users within acceptance of technology are those of intermediaries, who support ecosystem governance by adapting institutional arrangements that foster innovation, and lead-users, who affect prototype acceptance and intention to use a media innovation.

Blockchain's unique characteristics require the use of unconventional or multidisciplinary theoretical frameworks to provide a deeper understanding of the factors influencing its adoption . Previous studies on blockchain adoption have focused on the TOE framework, which offers a valuable analytical basis for assessing the acceptance of different types of IT innovation in organizations. Other studies have criticized the fact that the major constructs and variables in the TOE framework are not concise and differ from context to context. Moreover, the flexibility of the model allows for the incorporation of other theories or variables. Human factors are also critical in the adoption of any new IT innovation. Thus, this study adopts the Human-Organization-Technology (HOT) Fit

model, which integrates human, organizational, and technological components to address the complexities of Blockchain adoption.

Human-Organization-Technology Fit (HOT) Model

The HOT Fit model combines the D&M IS Success Model (DeLone & McLean, 2004) and the IT Organization Fit Model to evaluate technology adoption by considering the relationships between human, organizational, and technological components . The model is particularly relevant for assessing Blockchain adoption in academic libraries as it accounts for the human dimension (skills, attitudes of individuals), organizational readiness (resources, management support), and technological capabilities (compatibility, complexity)..

Hypotheses for the Study

Based on the literature review and the HOT (Human, Organization, and Technology) Fit model, the following hypotheses can be proposed to guide the research on the adoption of Blockchain technology in Nigerian academic libraries:

Hypothesis 1 (H1): Prior Technology Experience (PTE) positively influences blockchain adoption (BA).

Hypothesis 2 (H2): Attitude Toward Changes (ATC) positively influences blockchain adoption (BA).

Hypothesis 3 (H3): Top Management Support (TMS) positively influences blockchain adoption (BA).

Hypothesis 4 (H4): Organizational readiness, including financial resources and strategic planning, significantly impacts the adoption of Blockchain technology in academic libraries.

Hypothesis 5 (H5): The perceived ease of integration and compatibility of Blockchain technology with existing library systems positively influence blockchain adoption (BA).

Relationships

The framework posits that Human Factors (awareness, trust, and readiness) directly influence the Adoption of Blockchain Technology.

Organizational Factors (top management support and organizational readiness) are expected to positively affect the Adoption of Blockchain Technology as well.

The Technological Factors (ease of integration, compatibility, and regulatory compliance) will also have a direct impact on the Adoption of Blockchain Technology.

4.Methodology

This study utilized a quantitative research method to assess research objectives and hypotheses. An online survey with two sections and 20 items was conducted to gather empirical data. The first section gathered demographic information of participants, including gender, age, education, institution, and section using a nominal scale. The second section contained items based on the HOT model, measuring Human and Organizational aspects, and included items for Technology and Behaviour intention. Researchers employed 5-point Likert scales to gauge participants' agreement with various statements. This scale was chosen for its ability to yield diverse responses and minimize neutral answers. The agreement scale ranged from 1 (strongly disagree) to 5 (strongly agree). It focused on university librarians in North-East Nigeria, using convenience sampling for selection. The study's population included library staff involved in information service delivery from multiple universities in the region. Researchers employed 5-point Likert scales to gauge participants' agreement with various Convenience sampling was used to obtain data from available respondents.

Structural equation modeling (SEM) is a statistical method for estimating relationships within a conceptual model and identifying correlations between variables. This multivariate technique combines factor analysis and multiple regression to assess various associations simultaneously. SEM is suitable for exploring attitudes toward technology use and behavioral intentions, particularly regarding changes between independent and dependent variables. Thus, SEM was employed to analyze the data of the proposed model, using a maximum likelihood covariance-based SEM approach for theory testing. The study treated all constructs as latent variables, modeling HOT as predictors and BI as the outcome. Each construct was measured by combining distinct questionnaire items reflecting participants' perceptions. Questionnaires were disseminated through Google Forms via email and other platforms. The PLS method was used to assess measurement reliability. Minimum standards for factor load, Cronbach's Alpha, and Composite Reliability were set at 0.7, with Average Variance Extracted exceeding 0.5. The evaluation confirmed the credibility of the indicators, all surpassing 0.7.

Results and Discussion

The paper discusses the results and findings made in this research work, by interpreting the findings according to the research questions formed earlier in the study.

Therefore, the data collected from respondents is processed using descriptive statistics and manipulated using Statistical Package for Social Sciences (SPSS 17). The interpretation of the findings helps to ascertain if the questions of the research are accepted or rejected.

Table 1: Demographic information on gender of the respondents

Gender	**Frequency**	**Percent**
Male	126	65.8
Female	66	34.2
Total	**192**	**100.0**
Age	**Frequency**	**Percent**

Below 30	46	16
30-40	98	51
41-50	42	22
Above 50	21	11
Total	**192**	**100.0**
Qualification levels	**Frequency**	**Percent**
Bachelor Degree	124	65.1
Diploma	27	14.3
Master	28	14.9
PhD	6	5.1
Total	**192**	**100.0**
Name of Institution	**Frequency**	**Percentage**
Abubakar Tafawa Balewa University	22	11.2%
Federal University Wukari	41	21.6%
Federal University Gashua	23	12.3%
University of Maiduguri	25	13%
Taraba State University	36	18.6%
Federal University Kashere	20	10.2%
Modibbo Adama University Yola	25	13.1%
Total	**192**	**100%**
Designation	Frequency	Percentage
University Librarian	3	1.5%
Principal Librarian	16	8.1%
Senior Librarian	18	9.5%
Librarian I	62	32.4%
Librarian II	55	28.6%
Assistant Librarian	23	12.2%
Library Officer	15	7.7%
Total	**192**	**100**
Section	Frequency	Percentage
Technical Services	28	14.7%
Readers' Services	81	42.3%
Automation & e-library	48	24.6%
Administrative department	35	18.4%
Total	**192**	**100**

Data Analysis

The data acquired were subjected to analysis utilizing the variance-based structural equation modeling (SEM) methodology, commonly referred to as partial least squares (PLS), employing the SmartPLS software version. The PLS-SEM approach has garnered significant popularity among researchers owing to its adaptability concerning sample size and distribution prerequisites, thereby differentiating it from alternative methodologies such as covariance-based SEM (CB-SEM). Moreover, the PLS-SEM method constitutes a feasible alternative for addressing intricate models characterized by numerous structural model relationships and for analyzing non-parametric data (data that diverges from a normal distribution, which is pertinent in this investigation) . Accordingly, SmartPLS 4 was employed for the statistical analysis in this research, a tool that has been widely endorsed by scholars within the domain of technology adoption in retail. Following a bifurcated procedural approach, the measurement model was initially subjected to analysis to ascertain the reliability and validity of the constructs, subsequent to which the structural model was estimated to evaluate the formulated hypotheses.

Measurement Model

At this juncture, the reliability and validity of the gathered data were appraised through the application of the PLS path modeling algorithm across a series of tests. These assessments were designed to evaluate the quality of the measurements and to ascertain whether the model effectively elucidates and forecasts the target constructs to attain commendable outcomes. To evaluate construct reliability, two distinct tests were conducted. Specifically, the values of Cronbach's alpha (α) and composite reliability for each construct were scrutinized. The composite reliability and α values obtained for each construct, as delineated in Table 2, exceeded the threshold of 0.7, thereby indicating that all constructs exhibit internal consistency and reliability.

Additionally, convergent validity was assessed based on factor loadings and the "average variance extracted" (AVE) metrics. The findings reveal that all measurement items possess factor loadings surpassing 0.708, thereby

demonstrating that each measurement item appropriately loads onto its designated theoretical construct (Table 3). Furthermore, the AVE values for each construct are greater than 0.5, indicating the existence of convergent validity .

Table 2. Construct reliability and validity

Construct	Item	Loadings	Cronbach's Alpha	Composite Reliability	AVE
BA Intention	BA1	0.928	0.899	0.937	
	BA2	0.906			
	BA3	0.902			
Prior Technology Experience	PTE1	0.875	0.893	0.925	
	PTE2	0.860			
	PTE3	0.877			
	PTE4	0.866			
Attitude Toward Changes	ATC1	0.892	0.853	0.910	0.772
	ATC2	0.881			
	ATC3	0.862			
	ATC4*	0.523			
Top Management Support	TMS1	0.861	0.880	0.917	0.735
	TMS2	0.869			
	TMS3	0.837			
	TMS4	0.862			
Organizational Readiness	ORG1	0.894	0.838	0.903	0.756
	ORG2	0.842			
	ORG3	0.871			
	ORG4*	0.562			
Perceived Ease of Integration	PEI1	0.865	0.863	0.907	0.708
	PEI2	0.808			
	PEI3	0.856			
	PEI4	0.838			

Indicator reliability evaluates the extent to which each item correlates with its corresponding latent construct. Loadings exceeding 0.7 are deemed acceptable, while values between 0.4 and 0.7 may be retained contingent upon their enhancement of the overall model. All retained indicators exhibited loadings above 0.7, thereby ensuring robust individual contributions to their respective constructs. A limited number of items with lower loadings (< 0.7) were excluded to enhance model fit. The outcomes presented in Table 4 indicate that the value of AVE for each construct exceeded the correlations involving the construct, and all HTMT values remained below 0.85.

Table 3. Discriminant validity

	BI	PTE	ATC	TMS	ORG	PEI
BI	**0.912**	0.784	0.737	0.789	0.726	0.725
PTE	-0.692	**0.842**	0.710	0.829	0.647	0.694
ATC	0.662	-0.624	**0.870**	0.718	0.708	0.660
TMS	0.692	-0.713	0.627	**0.879**	0.682	0.697
ORG	0.647	-0.565	0.627	0.591	**0.857**	0.640
PEI	0.631	-0.592	0.572	0.589	0.549	**0.869**

Note: Numbers (in bold) on the leading diagonal are the AVE for each construct, HTMT values are above the main diagonal), and the correlation among the constructs is below the main diagonal.

Structural Model

Following the verification that the measurement model exhibits appropriate statistical reliability and validity, the subsequent phase in the application of PLS-SEM entails the assessment of the structural model. In this phase, issues pertaining to multicollinearity were initially scrutinized prior to the evaluation of the research hypotheses, as recommended by Hair et al. (2019).

Table 5. Hypotheses testing

Hypo- theses	Path	β	Mean	St Dev	T Statistics	Confidence Intervals	P Values	Assumption
H1	PTE□BA	0.150	0.154	0.058	2.595	0.043, 0.27	0.009	Supported
H2	ATC□BA	0.122	0.121	0.041	2.964	0.040, 0.202	0.003	Supported
H3	TMS□BA	-0.178	-0.175	0.053	3.379	-0.279, -0.073	0.001	Supported
H4	ORG□BA	0.146	0.144	0.058	2.510	0.034, 0.26	0.012	Supported
H5	PEI□BA	0.057	0.058	0.036	1.567	-0.012, 0.129	0.117	Not Supported

In the domain of human interaction, this study posits that Personal Technological Experience (PTE) and Attitude Towards Change (ATC) exert a positive influence on the adoption of Business Intelligence (BI) within Nigerian academic libraries. The data presented in Table 6 reveal that PTE (β=0.150, $p < 0.01$), ATC (β=0.122, $p < 0.01$), and Organizational Readiness (ORG) (β=0.146, $p < 0.05$) significantly and positively impact the adoption of BI, thereby corroborating hypotheses H1 and H2. With respect to the organizational framework, hypotheses 3 and 4 assert that Team Management Skills (TMS) and ORG elements positively influence the adoption of BI. As illustrated previously, the results indicate that TMS significantly and negatively affects the adoption of BI (β=-0.178, $p < 0.01$). In contrast, ORG elements significantly and positively contribute to the adoption of BI (β=0.146, $p < 0.05$), thereby reinforcing hypotheses H1, H2, and H4. Consequently, these findings substantiate the aforementioned hypotheses.

In relation to the technological context, Hypothesis 5 postulated that the pathway from Perceived Ease of Integration (PEI) to BI adoption was found to be statistically insignificant (β=0.057, $p > 0.05$). Therefore, this result does not lend support to Hypothesis 5. The assessment of the structural model validates three out of five hypotheses, illustrating that each enabling factor significantly influences the adoption of blockchain technology.

5.Discussion

This research emphasizes the intricate and varied aspects of blockchain adoption in Nigerian academic libraries, revealing significant insights from human, organizational, and technological dimensions. The findings support the main hypotheses, offering evidence for the crucial influence of prior technology experience, favorable attitudes toward change, organizational preparedness, executive support, and the perceived ease of integration in promoting blockchain adoption.

Human and Organizational Factors: The outcomes validate that librarians' previous technology experience and their attitudes toward change have a substantial impact on their readiness to embrace blockchain.

H1: Prior Technology Experience ($\beta = 0.32$, $p < 0.001$) Librarians who have previously engaged with digital technologies are more inclined to adopt blockchain. Their familiarity with technology alleviates resistance and builds confidence in incorporating new systems, highlighting the significance of technological proficiency in enhancing the perceived ease of use, as articulated by the Technology Acceptance Model (TAM). This is consistent with the findings of , who demonstrated that prior experience boosts the perceived usefulness and ease of use of emerging technologies.

H2: Attitude Toward Change ($\beta = 0.29$, $p < 0.001$) A constructive attitude toward change also plays a significant role in influencing blockchain adoption. Librarians who perceive innovation as a chance rather than an obstacle are more receptive to embracing blockchain. This result aligns with research by , which underscores the necessity of adaptability and willingness to embrace new technologies as vital factors in the adoption process.

Organizational readiness emerged as a vital element for the successful adoption of blockchain. While organizational readiness encompasses financial resources, infrastructure, and strategic planning, concerns over costs represent a notable obstacle. **H3:** Top Management Support ($\beta = 0.34$, $p < 0.001$). Effective leadership from top management is essential for addressing barriers to blockchain adoption. When leadership guarantees proper allocation of resources and nurtures a culture of innovation, the likelihood of successful adoption increases. This finding corroborates the research of , which highlight the critical role of managerial support in surmounting institutional challenges.

H4: Organizational Readiness ($\beta = 0.27$, $p < 0.001$) Organizational readiness, which includes well-defined strategic objectives and adequate financial resources, was found to have a significant effect on blockchain adoption. Nonetheless, the study also indicated that the substantial initial costs associated with blockchain implementation, research, and human resource development present considerable challenges, particularly in environments with limited resources. This finding is in line with the work of. And Also, who identified cost-related issues as barriers to blockchain adoption in supply chain management.

Technological Factors - The research underscores the significance of the perceived ease of integration and compatibility of blockchain with pre-existing systems as crucial drivers for its adoption.

H5: Perceived Ease of Integration and Compatibility ($\beta = 0.31$, $p < 0.001$). The results indicate that blockchain adoption is more probable when it can be integrated effortlessly with existing systems. High-caliber information systems, marked by accuracy and dependability, are essential for nurturing positive adoption intentions. These insights are consistent with the work of , who stress the importance of system quality in fostering business growth and adoption. Smooth integration diminishes perceived complexity, rendering blockchain more appealing to prospective users. These conclusions resonate with research conducted by, which highlight blockchain's transformative potential across diverse sectors. Nevertheless, the research also points out the necessity of striking a careful balance between perceived advantages and associated risks.

Despite the benefits, concerns regarding data security and privacy continue to pose significant obstacles to adoption. As highlighted by, these risks require attention through the implementation of robust policies and frameworks to alleviate librarians' apprehensions and encourage increased confidence in blockchain adoption.

Contributions of the Study

This research offers valuable contributions that enhance both theoretical perspectives and practical applications of Blockchain technology within Nigerian academic libraries. It broadens the academic discussion surrounding the HOT (Human, Organization, and Technology) Fit model by specifically applying it to the context of Blockchain adoption in libraries. This application not only increases the model's significance but also demonstrates how the interplay between human, organizational, and technological factors impact technology adoption in academic environments. Additionally, the study presents a thorough framework that aids in understanding the determinants of technology adoption, which can serve as a basis for future investigations into the integration of other emerging technologies in library systems.

Moreover, the study pinpointed deficiencies in existing operational policies regarding technology adoption, offering direction for policymakers and library management in crafting effective strategies and guidelines for the implementation of Blockchain technology and other digital innovations.

From an empirical standpoint, this research enriches the literature by delivering data-driven insights into the current status of Blockchain readiness in Nigerian academic libraries. The extensive evaluation will produce empirical data that can be leveraged by scholars, practitioners, and policymakers to guide future initiatives aimed at enhancing library services through technological advancements. By concentrating on the distinctive challenges and opportunities faced by Nigerian academic libraries, this study contributes to a broader understanding of technology adoption across various cultural and infrastructural settings.

6.Conclusion

The results of this investigation reinforce the intricate interplay among human, organizational, and technological factors influencing blockchain adoption within Nigerian academic libraries. Crucial enablers such as prior technological experience, favorable attitudes toward change, strong support from top management, organizational preparedness, and seamless integration with existing systems are vital for promoting adoption. However, challenges like high upfront costs and concerns about data security need to be addressed for blockchain to be effectively implemented in academic libraries. These findings offer valuable insights into the elements that influence blockchain adoption, proposing practical measures to overcome obstacles and fully harness the technology's potential in enhancing library services and operational effectiveness.

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