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Assessment of Factors for Blockchain Adoption Readiness in Tanzanian Public Healthcare Insurance Sectors: A Case Study of National Health Insurance Fund

Melkiades Aloyce [a, 1], Florence Rashidi[b], Deo Shao[c], Alcardo Alex Barakabitze[d]

[a]*Department of Information System and Technology, College of Informatics and Virtual Education, The University of Dodoma, Dodoma, Tanzania*
[b]*Department of Electronics and Telecommunication Engineering, College of Informatics and Virtual Education, The University of Dodoma, Dodoma, Tanzania*
[c]*Business School, University of Johannesburg, South Africa*
[d]*Department of Informatics and Information Technology, College of Natural and Applied Sciences, Sokoine University of Agriculture, Morogoro, Tanzania*

[1]Corresponding author
Email: m.aloyce@yahoo.com

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Keywords

Blockchain Technology,
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Adoption Readiness,
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Abstract

Blockchain technology offers various benefits, including efficient and verified record keeping, transparency and tracking, and cost optimization. This article assesses factors that impact adoption readiness of blockchain technology by 106 public health insurance sectors (PHISs) in Tanzania. The study examined integrated technology adoption frameworks, including Diffusion of Innovation (DOI), Technology Readiness Index (TRI), and Technology-Organization-Environment (TOE). Using this integrated TOE-DOI-TRI framework, the study proposed nine hypotheses related to adoption readiness of blockchain technology. The study also proposes an integrated technology adoption framework that can be used for future studies. Confirmatory factor analysis and structural equation modeling were used to test the hypotheses. Results demonstrate that relative advantage, technology compatibility, data security, government support, competitive pressures, top management commitment, partnerships and collaboration with experts as well as employee engagement have a positive influence on the adoption readiness of blockchain technology by Tanzanian PHISs. However, technological complexity hinders PHIS's adoption of the technology. This study reveals a paucity of literature that have attempted to identify the factors of PHIS technology adoption in Tanzania. The results will enable PHIS stakeholders to understand important factors in adopting blockchain technology. Additionally, our results can assist developers of this promising technology to generate customized solutions.

1. Introduction

1.1 Background

The recent progress in technological and scientific advances have revealed that the society is living in a digital era and has become more dependent on technology [1]. Technology makes life better for everyone, including how organizations and businesses execute their daily operations [2]. Contemporary approaches for managing business operations have been made possible by the remarkable advancement of computer technology and software [3]. Numerous sectors, including those in transportation, health, agriculture, education, finance, and economics, have taken on and utilized the most recent technological innovations, such as artificial intelligence and blockchain technology [4], [5].

The public healthcare insurance sector (PHIS) acts as an instrument of growth in Tanzania because of the contribution it makes towards ensuring that communities have access to affordable health services, thus ensuring a productive community [6]. In this context, a healthcare insurance scheme is a systematized financial plan that allows individuals to set aside funds to cover health care costs in the event of illness [7]. The concept of health insurance is based on pooling funds and entrusting these funds to a third party responsible for reimbursing group members [7]. These third parties may be a government agency, an employer institution or a private company, when subscribing members combine their funds to address a loss event, the insurer can cover costs by utilizing the pooled funds to handle individual cases [7], [8]. Consequently, healthcare insurance ensures affordable healthcare when numerous individuals collaboratively share the risk of excessive healthcare expenditures.

Blockchain technology is of precise importance to the public health insurance sector (PHIS) in developing countries, such as Tanzania. Several organizations across the world are implementing digital technologies, including blockchain, to enhance their daily operations in order to overcome this issue [9], [10]. For example, blockchain technology (BCT) has facilitated micro lending and ensuring trust among farmers in Kenya agricultural sector [11]. Additionally, BCT has facilitated high percentage of landowners to register and claim their lands in Ghana [11]. Furthermore, blockchain technology has played a vital role in tracking and authenticating the origin of coffee in Ethiopia [11].

Public healthcare insurance sector's application of Blockchain technology is expected to optimize operations and minimize operating costs, helping to improve performance and efficiency [12]. The benefits that PHIS gains from blockchain technology can enable insurer to operate more efficiently and competitively in dynamic market conditions. However, PHIS adoption of blockchain technology in developing countries like Tanzania faces major challenges due to various resource constraints, such as ICT infrastructure, lack of experts in the field, capital, and technology penetration [13]. A review of existing literature indicates that most of public health insurance sector in developing countries has not yet adopted blockchain technology [11]. Furthermore, there is limited number of studies that have been done regarding the adoption of the technology by PHIS in a developing country, such as Tanzania [11], [14], [15].

Existing studies have used various models and theoretical constructs to identify the determinants of blockchain technology adoption in several sectors [4], [16], [17]. One of the main limitations highlighted by most of these studies lies in using only a few antecedents to evaluate technological determinants. Therefore, it is necessary to use a comprehensive model to include the various available structures proposed by existing theoretical models and suitable for PHIS's adoption of blockchain technology. To achieve this goal, the

present study integrates three widely used models and theories, namely Technology-Organization-Environment (TOE) model, Diffusion of Innovations (DOI) theory, and Technology Readiness Index (TRI). The research results are expected to help PHIS understand the important factors they should pay attention to when adopting blockchain technology. Additionally, the research can benefit blockchain technology developers and providers as they can offer customized solutions based on these findings.

To meet the stated objectives, the present study has used the specified criteria of coverage and experience to identify an organization to be used as case study. The paper contributes to the existing literature by offering an insight into the factors influencing the adoption readiness of PHIS in Tanzania to blockchain technology in their operations. Hence, an opportunity is offered to the various stakeholders, including HIS, technology developers, vendors, and regulatory authorities to reflect on the determinants of intention to adopt blockchain technology. The study further contributes by putting forth a novel integrated technology adoption framework consisting of DOI, TOE, and TRI. The proposed framework may be employed to explore the determinants of blockchain technology adoption in various micro, small, and large organizations across the healthcare insurance sector and other sectors in Tanzania and abroad.

1.2 Theoretical foundations

1.2.1 Blockchain technology

In 2008, Satoshi Nakamoto coined the term "blockchain technology" as part of the process of identifying and explaining the double-spending problem in the context of digital currencies [18]. It has been observed that digital currencies can be duplicated in online transactions, requiring third-party verification, often provided by financial institutions [19]. To solve this problem, Nakamoto proposed a peer-to-peer network that could facilitate the direct transfer of digital currency from one party to another, thereby eliminating the need for third parties and effectively solve the double spending problem [18].

According to Jabbar et al. [20], blockchain technology (BCT) consists of a shared, encrypted database that acts as a permanent, immutable public repository of information; also, BCT ensures that all transactions are recorded and confirmed by the parties involved according to established rules. In BCT, different entities participate in the transaction function in the form of nodes (computers), and each participating node owns a copy of the distributed ledger, which is further connected to other nodes in the distributed peer-to-peer network [11]. Distributed ledger technology (DLT) manages the ledger of each node on the chain where business transactions, also known as blocks, are immutably stored in a ledger distributed across all participating nodes on the chain. The new block is added and linked to the previous block in the chain using a hash function and therefore the ledger data increases [21]. The hash is created using different hash algorithms and all blocks remain connected while ensuring that the hashes connecting two blocks remain immutable. Each block has a timestamp with the date and time it appeared. Cryptographic hashing ensures that, to modify an entry in the previous block, all subsequent blocks must also be modified. The ledger is validated and maintained by a network of nodes according to a predefined consensus mechanism with multiple nodes holding a complete copy of the entire database, eliminating the need for a single centralized authority. Every change and transaction validation is the result of consensus among network members, and each member can trace the origin of the transaction [22].

1.2.2 Healthcare insurance sector and blockchain technology

Different stakeholders participating in information, and cash flow in the health insurance industry, include insurers, members/patients, healthcare service providers, and regulatory agencies [23]. Application of blockchain technology in PHIS is expected to improve the overall performance and reliability of the sector by enabling various value-added tasks like one-point data entry, storing, tracking and sharing of information with speed and accuracy. In PHIS, blockchain will help to track members from the time of enrolment for a health insurance program to the time of reimbursement for costs spent accessing medical services from service providers. By doing this, it will help PHIS in Tanzania streamline its claims processing process, prevent fraud, reduce operating costs and improve service delivery.

As in Figure 1, with the current conventional methods in processing and storage of information in PHIS, each stakeholder in PHIS (insurer and service provider) collect electronic data, process and stores them on their central servers of which the insurer has no direct access to healthcare provider patient records. This leads to slow processing of claims, data breach and manipulation of bills by the service provider before submission to insurer for payment processing, leading to increase in fraud practices [24]. Also, there is no patient record sharing between service providers [20], which attracts provision of similar services to patient when visiting several facilities and hence raising insurance cost. Thus, introducing BCT (Figure 2) ensures the insurer has an access to patient information instantly to track the treatment history and process claims timely [20]. Also, healthcare providers have access to treatment history across different facilities, so they can use the history to attend the patient and avoiding repeated services, therefore minimizing insurer operational cost. Due to its immutability and timestamping feature, blockchain technology, when applied in PHIS, does not allow any type of modification or manipulation of outdated data, making it trustworthy and more transparent when used. Additionally, with its highly secure distributed consensus and encryption mechanism, blockchain technology improves data security and provides an environment protected against cyber-attacks.

Technology adoption readiness can be defined as the state of willingness and preparedness for the process of implementing a new technology or innovation and making it available to end users [26]. Existing literature shows different models and theories of technology adoption readiness, such as Theory of Reasoned Action (TRA), TOE Framework, DOI, Technology Acceptance Model (TAM), and TRI, has been used by researchers to express the factors that influence adoption readiness to technology. Different models used by existing studies include TAM [25], UTAUT [26], DOI [27], TOE [28], Combination of TAM, TRI and TPB [29], also combination of TAM, DOI and UTAUT [30]. These studies have highlighted various factors that influence the willingness to adopt blockchain technology in several sectors, including health insurance. These factors include relative advantage, compatibility, complexity, top management commitment, costs, market dynamics, competitive pressures, legal support, security, perceived benefits, perceived usefulness, organizational readiness, organizational size, and data governance [31, 32]. For the Tanzanian context, few studies have attempted to examine the adoption readiness of blockchain technology in different sectors [15, 33, 34]. This shows that there are limited research that evaluate factors that have impact on adoption readiness of blockchain technology in the public health insurance sector in Tanzania, necessitating a need to explore this area further.

To examine the adoption readiness factors for blockchain technology in PHIS, the present study examines the TOE framework, DOI theory, and

TRI to propose an integrated TOE-DOI-TRI framework. The TOE framework determines technology adoption readiness at the organization level by considering the technological, organizational, and environmental context [35]. The technological context takes into account the internal and external factors of new technology to the organization. Organizational context includes company characteristics, such as organizational structure, departmentalization, personnel roles, and level of control. Environmental context also refers to the legal environment, market factors and competitors. Several literature shows the use of the TOE framework to examine blockchain technology adoption readiness factors [13], [36]. DOI Theory examines user reaction and acceptance of a new concept by focusing on elements like relative advantage, technological compatibility, technological complexity, observability of innovation, and trainability of the technology to explore the rate of adoption of a new technology [32]. Several studies have used this theory in assessing the adoption readiness of blockchain technology [27], [32]. Parasuraman [37] developed the TRI dimension to assess a company's readiness to adopt new technology [37]. Technological readiness can be defined as "customers' willingness to adopt new technologies to improve efficiency in life and work". This is a workable theory that can be used to understand how people adopt new technology [17].

The present study shows that the different variables of TOE and DOI play an important role in influencing PHIS users' willingness to adopt blockchain technology. Hence, the TOE-DOI-TRI framework was suggested in addressing the objectives of the study. TOE explores technology adoption by considering business-level factors. Additionally, the DOI takes into account the attributes of the innovation that can attract technology adoption. Considering the objectives of the present study, nine factors of technology adoption under three aspects of technology context, organizational context, environmental context adapted from the integrated TOE-DOI-TRI framework are found relevant. In the case of technological aspects, three properties of DOI theory and TOE framework, namely relative advantage, data security assurance, technological compatibility and technological complexity, were considered. The organizational context of TOE determines the role of top management commitment, employee involvement, and expert collaboration and partnership in influencing readiness to adopt blockchain technology in PHIS. Additionally, the environmental context of the TOE framework considers the contribution of government support and competitive pressures in influencing the PHIS purpose.

1.3 Hypothesis development

The review of relevant literature and the integrated TOE-DOI-TRI model revealed the relevance of three contexts with nine factors that influence adoption readiness of blockchain technology in PHISs (Figure 3).

1.3.1 Technological context

The four attributes considered as technological characteristics for the adoption readiness of blockchain technology in PHIS are relative advantage, technological compatibility, data security and technological complexity. The relative advantage of a technology can be explained as the degree to which the benefits it provides are considered better than those provided by existing technology [16]. The application of blockchain technology in PHIS is expected to provide distinct features such as data transparency, reliability as well as immutable and verifiable records verified by timestamp [22], [32]. Existing studies have found relative advantage to be an important factor in the adoption of blockchain technology by organizations [31], [38].

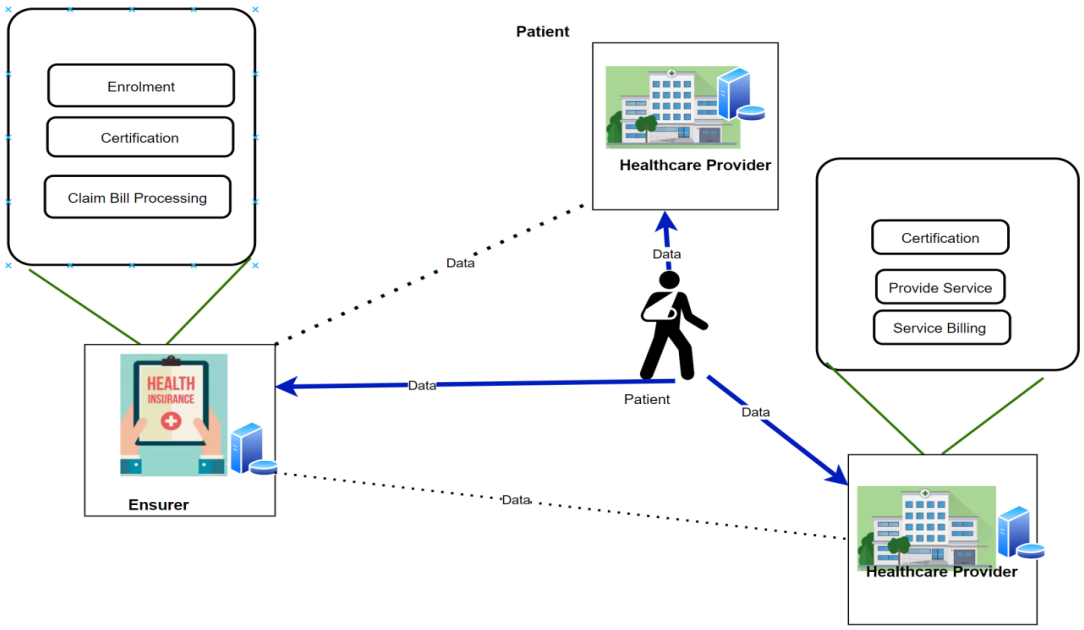

Figure 1. Current healthcare insurance process.

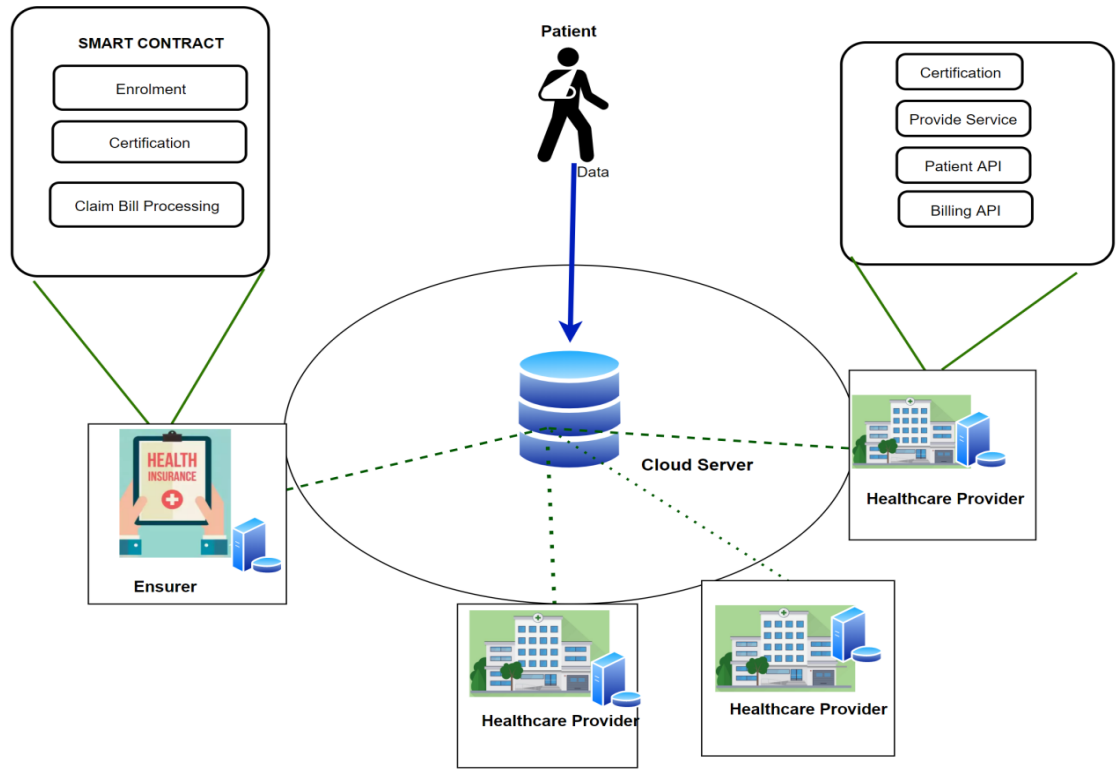

Figure 2. Blockchain technology and healthcare insurance process.

Technology compatibility has been explained in terms of its consistency with the current needs, current values, and past experiences of the potential adopter [7]. In addition, technology compatibility also involves consideration of organizational culture and available technology infrastructure [39]. It will be easier for an organization to apply blockchain technology to its operations if it has a high level of compatibility [40]. Existing studies show that the compatibility of blockchain technology positively influences organizations' adoption readiness to the technology [40], [41]. Data security describes the security level of data or information shared through technology [10], [42]. It will be easier for an organization to apply blockchain technology to its operations if there is data security confidence [20]. Existing studies have confirmed that the security guarantee provided by the use of blockchain technology has a positive influence on organizations' intention to adopt it [34], [43]. The complexity of technology is associated with the relative difficulties in understanding and using it. According to existing studies, the complexity of blockchain technology is considered as a major obstacle to its adoption in several sectors it [27], [32]. Based on the above discussion, the following four hypotheses are formulated for the technological characteristics factors:

H1: Data security consideration positively contributes to the adoption readiness of BCT in PHIS.

H2: Compatibility with other technology positively influences the adoption readiness of BCT in PHIS.

H3: The complexity of BCT applications have impact on the adoption readiness of BCT in PHIS.

H4: The relative advantage offered by BCT over other technologies positively affects the adoption readiness in the PHIS.

1.3.2 Environmental context

Environmental context can be demonstrated by how an organization carries out its activities [37], [46]. It primarily focuses on the surrounding conditions during technology adoption, including competitors and government support. Government support means the extent to which the government standardizes its policies to facilitate the technological advancement in the organizations [43]. Additionally, government support can be viewed as to how the government provides support to the organization in terms of funding and infrastructure to easily adopt new technologies [35]. It will be easier for an organization to adopt and apply blockchain technology to its operations if there is high government support [36]. Existing studies have confirmed that government support for technological innovation has a positive influence on organizations' willingness to adopt BCT [36], [44]. Presence of competitors in the industry are the driving force for organizations to find a mechanism to capture the market through technological innovation [45]. It will be easier for an organization to adopt blockchain technology in its operations if it has a high level of trust that the technology will help it to outperform other organizations in the industry [32]. Existing studies have confirmed that the competitive pressures act as a catalyst that influences organizations' willingness to adopt BCT [32], [40]. The following hypotheses are proposed in this study regarding environmental characteristics:

H5: Competitive pressure positively affects the adoption readiness of BCT in the PHIS.

H6: Government support positively influences the adoption readiness of BCT in the PHIS.

1.3.3 Organization context

The organization perspective mainly focuses on top management commitment, employee involvement, Partnership and collaboration with

experts [49]. Top management commitment refers to the degree to which top organization management is committed to provide satisfactory resources, including effective championing, planning, and guidance, assessing, and monitoring of the organization in adopting new technology. These resources are important in supporting the adoption readiness of BCT within an organization [16], [44]. BCT is a recently technological innovation, implying that there are limited number of experts in the field [46]. Partnering and collaborating with experts in the field ensures that critical knowledge, expertise and support are available during BCT implementation, which can speed up the process of adoption and preventing adoption problems. Organizations in the public health insurance sector can benefit from the expertise, technical know-how and best practices of experts by collaborating with them. Employee engagement and training, active training and inclusion of individual employees in the innovation process at all levels have a positive impact on the public health insurance industry's preparedness for BCT adoption in PHIS. Employee engagement in BCT adoption can foster a culture of innovation, enhance knowledge exchange, and facilitate the study of real-life use cases and implementation plans in the context of public health insurance. Concerning the BCT adoption readiness, several scholars pointed out that top management commitment, employee involvement, partnership and collaboration with experts to be essential factor in adopting BCT at the organization level [47], [48]. The following hypotheses are proposed in this study regarding organizational characteristics:

H7: Top management commitment positively affects the adoption readiness of BCT in PHIS.

H8: Partnership and collaboration with BCT experts positively contribute to the adoption readiness of BCT in PHIS.

H9: Employee involvement in innovation process positively affects the adoption readiness of PHIS.

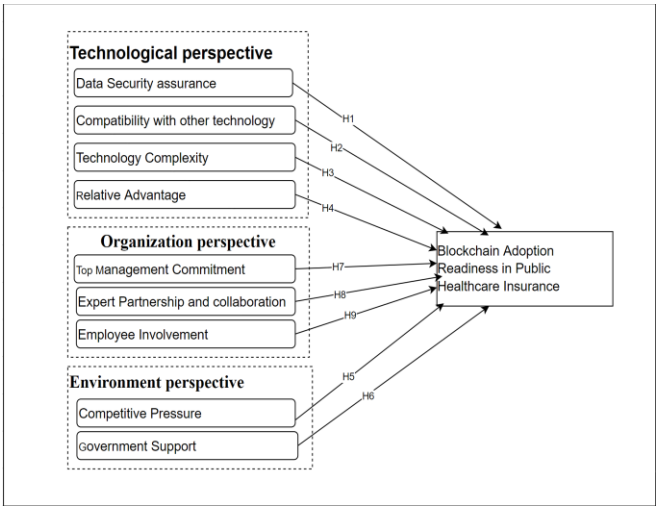

Figure 3. Conceptual framework.

2. Methods

2.1 Study population, sampling and data collection

The current study used quantitative research approach that involves data collection through surveys and personal interviews. Hence, a survey instrument in the form of a structured and pre-tested questionnaire was developed. Additionally, both primary and secondary data sources were used in the study. To collect secondary data, relevant research papers, articles and other publications were reviewed. The survey method used to collect primary data focused on the public health insurance sector in Tanzania, National Health Insurance Fund (NHIF) as study area. The NHIF Tanzania was selected because of its high coverage percentage of population compared with other healthcare insurance schemes (NHIF 8%, CHF 5.4%, 0.3% SHIB-NSS and 1% private schemes) [49]. Furthermore, NHIF Tanzania has been operating for more than 20 years as health insurance scheme (NHIF Tanzania, 2022). The target group for this study was made up of members of NHIF-Tanzania comprised of head office employees and subscribers, making 155 population yielding a

sample size of 112 respondents by applying Yamane's formula 1967 with level of precision of 0.05. Out of 112 respondents, only 110 responded with filled questionnaires. Due to the illegible responses or missing data, four filled questionnaires were rejected. Therefore, the final sample size for the study was 106 (Table 1).

Table 1. Sample description (NHIF-Tanzania n=106).

Category	Respondents	Percentage
Management	10	9.43
ICT staff	10	9.43
Other Staff	81	76.42
Potential Clients	5	4.72
Total	106	100

2.2 Data analysis

To protect the confidentiality of study participants, their identities were kept anonymous and not analyzed. Exploratory factor analysis (EFA) and structural equation modeling (SEM) were applied to analyze the data collected from 106 respondents. For this purpose, IBM SPSS Statistic 26 and Microsoft Excel 2016 were used. As recommended by Ruscio and Roche, EFA was performed before SEM to establish the basic structure of the factors [50]. The reliability of the scale and each subscale comprising individual factors was confirmed using Cronbach's alpha. Then, as suggested by Anderson and Gerbing, SEM was applied using two components, namely the measurement model and the structural model [51]. Firstly, the measurement model is built to use multiple indicators to measure independent and dependent variables. This measurement model was further tested to verify model fit and construct validity through CFA. The structural model then incorporates the intention to adopt blockchain technology as the dependent variable and the various factors as the independent variables. Finally, a path analysis was performed to test the hypotheses.

3. Results

3.1 Demographic information

From the survey conducted, 106 valid responses (94.6%) of the sample out of the 112 expected responses were received (Table 2). Since 99 percent of respondents were under 50 years, it is possible that they will continue to work for at least another 10 years before retiring, and may be taken into account while developing the blockchain adoption plan. A familiarity with the procedures and difficulties involved in health insurance is demonstrated by the fact that 92.45% of respondents had worked in the healthcare insurance sector for more than three years.

As illustrated in Table 2, only 4.72% of respondents demonstrated the ability to develop and implement blockchain applications, indicating a lack of blockchain expertise in the sector. Since blockchain applications must be created, installed, and maintained, employees must receive extensive training and development, and working with external experts will help in the development of team members in the sector to manage blockchain applications to a greater extent.

3.1 Hypothesis testing

The significance of the hypothesis was evaluated in this study using the p-value and t-values, where the hypothesis is considered statistically significant if the p-value is less than 0.05 or the t-value is larger than 1.96 [9]. The use of p-values only as a criterion for determining the relevance of a hypothesis was criticized by researchers as being reliable [53]. In order to determine the significance of the hypothesis, this study combined the p-value and t-value. Table 4 presents the outcomes of the hypothetical test. H1, H2, H4, H5, H6, H7, H8 and H9 are accepted among the 9 hypotheses set proposed in this study since they pass the significance test with p-values less than 0.05 and t-values more than 1.96.

Table 2. Demographic information.

Basic Information	Category	Frequency	Percentage
Age Group (Years)	Below 30	3	2.83
	Between 30 and 40	58	54.72
	Between 41 and 50	44	41.51
	Above 50	1	0.94
Years in the healthcare insurance sector	Below 3	8	7.55
	Between 3 and 5	15	14.15
	Between 6 and 10	32	30.19
	Above 10	51	48.11
Respondent Role	Decision maker	24	22.64
	General user	82	77.36
Possessing blockchain skill	No	54	50.94
	Basic (can use blockchain)	38	35.85
	Intermediate (can support blockchain)	9	8.49
	Advanced (can develop and install blockchain)	5	4.72

Table 3. Reliability and validity test.

Construct	**N**	**Mean**	**Std. Dev**	**Cronbach's Alpha**	**CR**	**AVE**
Compatibility with other technology (COT)	106	2.2	.747	0.777	0.814	0.594
Top management Commitment (TMC)	106	2.3	1.097	0.820	0.887	0.723
Employee Involvement (EI)	106	2.7	.743	0.768	0.796	0.566
Government Support (GS)	106	2.3	1.156	0.806	0.872	0.694
Data Security Assurance (DSA)	106	2.1	.794	0.729	0.756	0.513
Expert Partnership and Collaboration (EPC)	106	2.2	.777	0.824	0.766	0.523
Relative Advantage (RA)	106	2.2	.683	0.928	0.798	0.569
Technology Complexity (TC)	106	3.5	1.743	0.823	0.750	0.501
Competitive Pressure (CP)	106	2.3	.879	0.798	0.761	0.523
Blockchain Adoption Readiness (BCTAR)	106	2.1	.850	0.809	0.730	0.730
ICT Infrastructure Assessment	32					
Change Management	29					
Funding Source	25					

Table 4. Hypothesis testing.

No	Path	R2	t-Value	p-value	Result
H1	Data security consideration → adoption readiness	0.330	2.114	0.037	Supported
H2	Compatibility → adoption readiness	0.410	2.168	0.032	Supported
H3	Complexity → adoption readiness	0.497	1.464	0.146	Not Supported
H4	Relative advantage → adoption readiness	0.787	2.630	0.010	Supported
H5	Competitive pressure → adoption readiness	0.442	3.227	0.002	Supported
H6	Government support → adoption readiness	0.500	6.231	0.000	Supported
H7	Top management commitment → adoption readiness	0.515	5.780	0.000	Supported
H8	Partnership &collaboration → adoption readiness	0.495	2.022	0.046	Supported
H9	Employee involvement → adoption readiness	0.396	2.276	0.025	Supported

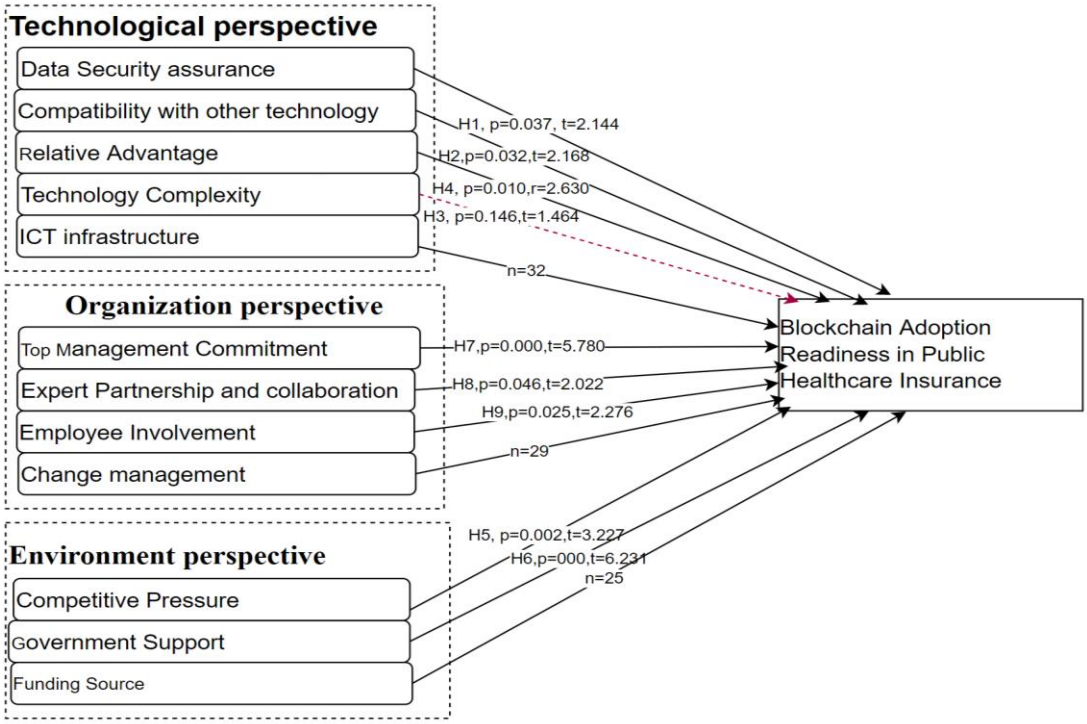

Figure 4. The structural framework.

Data security assurance (H1, p< 0.037, t>2.114), compatibility with other technology (H2, p<0.032, t>2.168). Relative Advantage (H4, p< 0.010, t>2.630). Competitive Pressure (H5, p<0.002, t>3.227). The relationship between Government (H6, p< 0.000, t> 6.231), Top Management Commitment (H7, p <0.000, t>5.780), Expert Partnership and collaboration (H8, p<0.046, t>2.022. The significance was r 0.396, Employee Involvement (H9, p<0.025, t>2.276). H3 was eliminated since its t-value was less than 1.196 and its p value was greater than 0.05, which does not meet the criteria, Technology Complexity (H3, p=0.146, t=1.464). Figure 4 presents the structural framework as described in this subsection.

4. Discussions

4.1 Technological context and adoption readiness of BCT in PHISs

Given that BCT has robust information security features, including immutability, transparency, and decentralized control, it can address concerns about the security of patient data [54]. In addition, the technology behind blockchain eliminates the need for a single administrative officer, and it can successfully manage who accesses any information that is stored within the shared ledger, providing it with outstanding security and programming proof features [55]. The empirical results of this study have demonstrated the important role that data security assurance plays in the adoption of BCT in PHIS. These findings are consistent with those of other studies that have looked at the significance of the data security feature of blockchain adoption in a variety of industries, including the financial and healthcare sectors [6, 54, 56]. In blockchain technology compatibility, the efficient flow of data information between various platform systems is one of the keys to the effective application of the blockchain system in the healthcare insurance sector. This requires interoperability between the blockchain and the industry's working manner, software, and system platforms [6], [22].

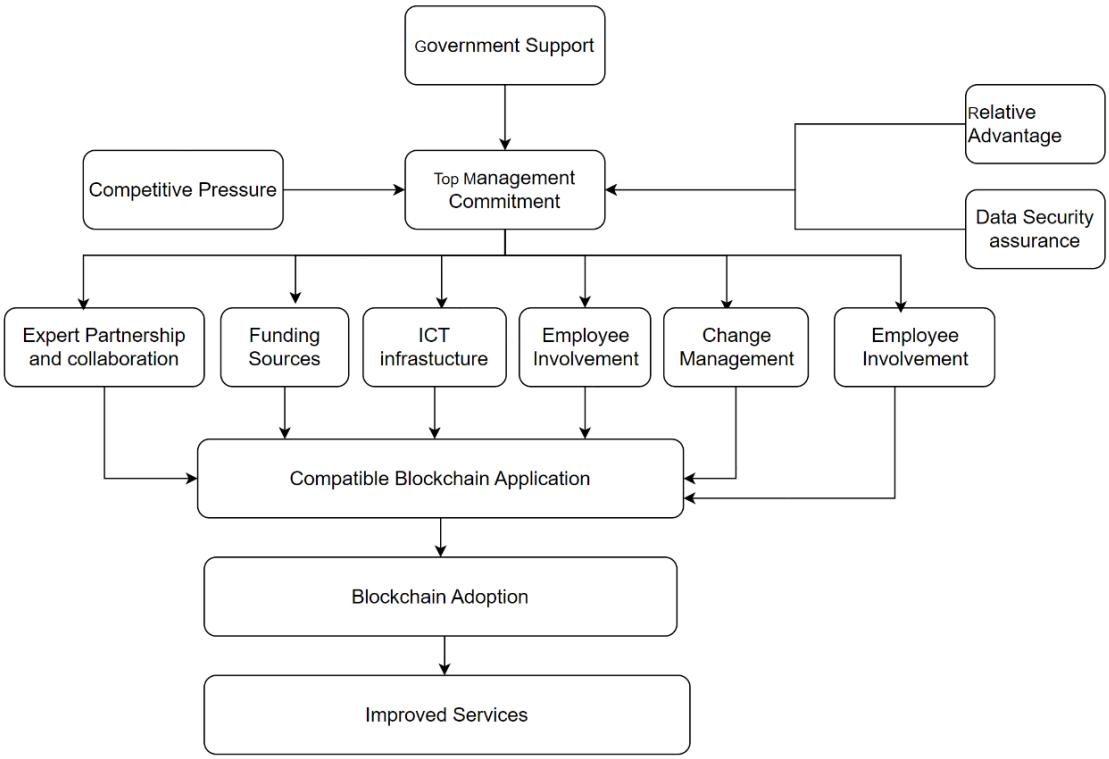

Figure 5. Blockchain adoption framework.

The empirical findings of this study suggest that compatibility of BCT with other technologies have positive impact in the adoption of BCT in PHIS. This also is supported by other studies' assertions that the compatibility of BCT with other systems acts as a catalyst for the adoption of this technology[57], [58].

However, it is worth noting that technology complexity generally has a detrimental effect on the readiness for blockchain adoption. The existing literature, as indicated by Putteeraj et al. [27], highlights that complexity-related issues tend to be more pronounced in developing countries, and nearly all studies in the literature underscore their adverse impact on the readiness for adopting BCT. The empirical findings of this study showed complexity to have negative effect on blockchain adoption readiness in public healthcare insurance sectors. The results have been supported by previous literature which shows that complexity difficulties are more prevalent in developing countries, and simplicity of use promotes developing countries to adopt new technology/innovation [56], [59].

The blockchain relative advantages over others are mainly reflected in the transparency, traceability, decentralization tamper-proof, and intelligent function [3], [22]. These technical features can increase operational effectiveness, cost savings, enhanced data security, and stakeholder trust in the Public healthcare insurance sector [27]. The results of this study suggest that relative advantage of BCT applications over others have positive contribution in adoption readiness of BCT in PHISs. This finding agrees with other studies in various industries that have demonstrated the impact of relative advantage in blockchain adoption [22], [59]. BCT applications needs adequate and high performing ICT infrastructures, such as computer hardware, software and network connections for its successfully and reliable operations. This is due to the fact that BCT applications are capable of transacting huge amount of data and at high speed to attain its potentiality. The results of this study suggest that having adequate and reliable ICT infrastructure plays a good role in the adoption readiness of BCT. This finding agrees with other studies in various industries that have demonstrated the impact of relative advantage in blockchain adoption [22], [60]. Considering the above, it can be presumed that technological characteristics have a significant impact on the adoption readiness of PHIS to blockchain technology.

4.2 Environmental context and adoption readiness of BCT in PHISs

The presence of competitors in the sector is a driving force for the organization to find the mechanism to win the market through technological innovations [45]. The results of this study show that the adoption of BCT is positively impacted by competitive pressure. These results are consistent with those of studies by Lu et al. [32], who discussed the impact of competition on the adoption of technology in the elderly care sector. Government support can be described as a commitment to supporting of innovation and provision of resources, funds, or legislative incentives expressed for technological innovation. Government ICT policy and legalization refer to the support given by the government authority to encourage the assimilation of IT innovation by firms [36], [44]. The results of this study discovered that government support for innovation promotes the adoption readiness of blockchain in PHISs. This is consistent with the findings of Lu et al., [32] , who proposed that one of the contributing factors in the adoption of BCT in elderly care sector is the support of the government. It can, therefore, be presumed that environmental characteristics have a significant impact on the adoption readiness of PHIS to blockchain technology.

4.3 Organizational context and adoption readiness of BCT in PHISs

Top management commitment is needed for a successfully adoption of BCT in PHISs. This is because they are in charge of allocating resources, prioritizing technological efforts, and coordinating organizational objectives, all of which are essential for the successful adoption of technology. The empirical data collected for this study demonstrated that top management commitment is one of the factors influencing BCT adoption readiness in PHISs. This is consistent with the study suggesting that when the top management is committed, it will offer leadership, guidance, and support needed to overcome change-related resistance, allocate resources, and drive the adoption process [61]. Collaboration and partnership with blockchain experts, assuring the availability of important knowledge, expertise, and assistance in deploying BCT, establishing cooperation and collaboration with experts can accelerate the adoption process and prevent adoption issues. Organizations in the public healthcare insurance sector can profit from the expertise, technical know-how, and best practices insights from specialists by collaborating with them. The result of this study demonstrates that having partnership and collaboration with blockchain experts play an important role in ensuring successfully adoption of BCT in PHISs. The findings support other studies suggesting that, because the technology is new, many developing countries lack experts in the field. Therefore, having a partnership and collaboration with experts both internal and foreigner will ensure the technology is implemented successfully [46]. Furthermore, employee participation in the adoption of BCT can promote an innovative culture, increase knowledge exchange, and make it easier to find real-world use cases and implementation plans in the context of the public healthcare insurance business. The other factor that was proposed by respondents in organization aspect was Change Management.

5. Conclusion and Recommendations

5.1 Conclusion

The present study explores the factors that have impact on adoption readiness of BCT in PHISs. The integrated TOE-DOI-TRI framework, which includes technological context, organizational context, and environmental context was used. Out of the nine proposed hypotheses, eight were confirmed by the study. The results show a significant influence of relative advantage, technology compatibility, data security assurance, government support, competitive pressure, top management commitment, partnership and collaborating with experts, and employee participation in adoption readiness of PHIS to BCT. The study further shows that the complexity of technology is one of the main reasons why people are hesitant to adopt it.

This study contributes to filling an important gap in the academic literature as there are limited studies that have attempted to pinpoint adoption readiness factors for PHIS technology adoption in developing countries, such as Tanzania [11], [34], [62]. Furthermore, the study proposed a new integrated technology adoption framework consisting of DOI, TRI and TOE. This is a comprehensive model that includes various backgrounds available to evaluate the bases of technology adoption readiness. This model can be used by academic researchers in Tanzania and globally to explore adoption readiness factors in the case of various emerging technologies. These findings can further help PHIS stakeholders, including regulators, technology developers, vendors and suppliers, as the research provides them with opportunities to realize factors that determine readiness to adopt blockchain technology in an organization. PHIS stakeholders will be motivated to adopt blockchain technology if

they are convinced with the relative benefits of the technology, such as data availability, transparency, and record verification. Blockchain technology developers should understand the compatibility requirements of PHIS and offer customized technology solutions.

Top management commitment is further revealed as an important factor in the decision of PHIS to adopt blockchain technology. In the Tanzania PHIS context, the top management generally refers to the final decision-making authority. An insurer will be more inclined to adopt blockchain technology if top management has a favorable commitment to the technology. This finding is important because this technology is perceived to be costly to implement, hence acting as an inhibitor to technology adoption if the top management does not provide sufficient resources. From Figure 5, top management commitment is the key component in the successfully adoption of BCT. By responding to competitive pressures, capitalizing on the technology's relative advantages, ensuring data security through the technology, and securing government support, the management will undertake a series of actions. These include collaborating with experts, exploring funding sources, upgrading ICT infrastructure, conducting risk assessments of the technology, improving the change management process, and ensuring that employees are actively engaged in the adoption process. These combined efforts will pave the way for the seamless and successful adoption of blockchain in the public healthcare insurance sector. The successful adoption of blockchain technology in the public healthcare insurance sector will significantly enhance services within the sector. This will be achieved by lowering operational costs, mitigating fraud practices related to insurance schemes, enhancing transparency, ensuring data security, and promoting data integration. Consequently, a larger portion of the citizenry will benefit from insurance coverage, ultimately leading to improved community health across the country.

5.2 Recommendations for further research

This study is based on assessing the factors that have impact on adoption readiness to a limited sample of 106 NHIF stakeholders in Tanzania. Therefore, the attention should be drawn to this aspect when generalizing our findings. In future, research on the application of blockchain technology can be carried out in the health insurance sector in Tanzania and other regions. Future research could further be engaged in longitudinal studies to explore the factors influencing the adoption of blockchain technology in various types of organizations in the health insurance industry, which would help developers ensure customer-specific changes to their services. The application and adoption of blockchain technology can also be explored in various contexts, such as Internet of Things [63], surveillance systems [64], agricultural systems [67-71], quality of services [74, 76, 78], [80-82] and networked systems [73, 76, 78, 83, 84] transportation systems [65], [85], health [75], [79] and hospitality [25]. Furthermore, future studies could extend the proposed TOE-DOI-TRI integration framework to explore the adoption factors of blockchain technology in different fields.

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APPENDIX

Appendix 1: Questionnaire Tool

Dear Participants, Greetings,

I humbly request you to take part in this study, which is an academic study on the blockchain adoption readiness in the Tanzania Public healthcare insurance sector. This study is meant for academic purposes only and the information collected will be kept confidential. Please answer the questions honestly and precisely. Thanks for your cooperation.

1. Gender……

   [ ] Male

   [ ] Female

2. Age Range (Years) …

   [ ] 18-30

   [ ] 31-10

   [ ] 41-50

   [ ] Above 50

3. How long have you been in Healthcare Insurance Sector (Years) …

   [ ] Below 5

   [ ] 5-10

   [ ] Above 10

   [ ] NA

4. What role do you play in in the organization with regard to Innovations?

   [ ] Decision maker

   [ ] General User

5. a) What systems/initiatives are currently used in your organization?

   .....

   b) What challenges do you face with the current systems/initiates?

   ……

   ……

6. a) Do you have any blockchain skills?

[ ] Yes

[ ] No

b) If yes what level of skills do you possess?

[ ] Basic (can use)

[ ] Intermediate (can support and maintain blockchain systems)

[ ] Advanced (Can develop and deploy blockchain applications)

7. Do you use smartphone in your daily life?

[ ] Yes

[ ] No

Please rate the following statements about the level of blockchain technology awareness using the following scale (1= Strongly Agree (SA), 2=Agree (A), 3= Neutral (N), 4= Disagree (DA), 5=Strongly Disagree (SDA))

SNO	Statement					
	Technology Complexity(TC)	1	2	3	4	5
TC1	The use of Blockchain Technology(BCT) requires a lot of psychological effort					
TC2	The skills needed to improve and use BCT are easy for me					
TC3	There is enough budget commitment for trainings in new innovations.					
	Compatibility with other technology (COT)	1	2	3	4	5
COT1	The use of blockchain is compatible with my healthcare corporate culture and value system					
COT2	The use of blockchain will be compatible with existing hardware and software					
COT3	Blockchain is compatible with existing emerging technologies					
	Top management Commitment(TMC)	1	2	3	4	5
TMC2	Top management commitment is important to provide the resources to adopt BCT					
TMC1	The management is ready to take risks (financial and organizational) involved in the adoption of blockchain.					
TMC3	Top management will support the adoption process of blockchain adoption					
	Employee Involvement(EI)	1	2	3	4	5
EI2	All users have been trained in basic technology skills in the healthcare system					
EI2	The existing ICT workforce can develop, support and maintain blockchain applications					
EI1	There is high involvement of employees in the adoption of innovation step by step					

	Government Support(GS)					
GS1	There is support from government on technology and innovations					
GS2	The government has setup infrastructures to support blockchain adopt					
GS3	The government drives the use of the technology through incentive programs					
GS4	Government IT policy can encourage sustainable technology usage					
	Data Security Assurance (DSA)	1	2	3	4	5
DSA1	The use of Blockchain can improve security of patients information sharing					
DSA2	Access to patients information from health facilities by healthcare insurance scheme will be safe					
DSA3	Forgery of treatment information will be controlled using BCT					
	Expert Partnership and Collaboration(EPC)					
EPC1	Partnership and collaboration with blockchain experts will contribute to its adoption					
EPC2	Partnership and collaboration with blockchain experts will minimize the failure risk of blockchain adoption					
EPC3	Partnership and collaboration with blockchain experts will equip ICT staff with blockchain skills					
	Relative Advantage(RA)					
RA1	The transparency of blockchain can promote data sharing and improve the utilization of medical information					
RA2	The non-tampering characteristics of blockchain are conducive to ensuring the authenticity and reliability of data information					
RA3	BCT will help to manage business operations in an efficient way.					
	Blockchain Adoption Readiness	1	2	3	4	5
BAR1	Are you ready to use BCT in your daily operations?.					
	Competitive Pressure (CP)					
CP1	The use of BCT can contribute to cost containment and increase healthcare insurance coverage					
CP2	The presence of competitors in healthcare insurance sector will enforce adoption of BCT					
CP3	The use of blockchain will differentiate the scheme with others in terms of services provided					

What other variable can be included in the framework?

……

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