Intention to adopt blockchain technology for collaborative business processes by academic libraries in South Africa

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By

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Abstract

Globalisation has compelled academic institutions to leverage digital innovations that present new capabilities and novel opportunities because of the stiff competition and movement restrictions during pandemic such as COVID-19, in their operating environments. In this digital era, academic libraries, like any other institution are compelled to re-think of their ways of providing information services to remain relevant to their communities as there are various other sources of information which attract users' attention.

Growing demand of information services, declining budgets, rapidly changing world around academic libraries and increase in prices are common challenges experienced by the university libraries globally, which are mostly too complex and large for the institutions to handle on their own. These challenges led to the consortia formation both in developing and developed countries for collective acquisition and sharing of resources. Collaborative technologies should, therefore, be adopted to integrate internal systems for seamless information exchange between different institutions and eliminate duplication of efforts. However, it becomes a challenge to integrate these systems across independent institutions because of lack of trust between the involved parties, in terms of who will control the collaborative business processes. For collaborative processes which are in place, academic libraries still depend on a third party to facilitate their collaborative activities, and consequently incur costs for coordination of such processes.

Blockchain represents one of the disruptive technologies with potential to streamline the collaborative activities across academic libraries with high level of trust without the third party intermediation. Although, blockchain technology has caught the attention of different industries, it is still at an infancy stage and yet to find its traction in various business processes.

The aim of this study was to investigate the intention to adopt blockchain technology for collaborative business processes by academic libraries in South Africa. The study was anchored in the Technology Adoption in Supply Chain (TASC) model which has been adapted to answer the research questions formulated. Quantitative research approach was adopted, using survey questionnaire. From the questionnaires sent to 23 South African academic libraries which are members of the regional consortia, only 95 usable responses have been collected and analysed using SPSS version 26.

Potential applications of blockchain technology were found to be in distributed metadata sharing, a credentialing system, and a library network connection to form Inter-Planetary File System (IPFS). However, participants are uncertain of the intention to adoption blockchain by their academic libraries. Looking at the results of the descriptive analysis, it is evident that academic library workers are positive about relative advantage, compatibility, IT readiness, and inter-organisational trust of blockchain technology in their profession. They are not aware and/or have mixed perceptions of the technology complexity, cost, management support, industry support, customer pressure, and security/privacy concern of blockchain technology. This warrants the need to impart knowledge about the technology and its potential value to their profession. Among the adoption factors included in the model, only customer pressure (CP) was found to be significant in influencing the intention to adopt blockchain, while relative advantage (RA), compatibility (CT), complexity (CX), perceived cost (PC), organisational size (OS), management support (MS), IT readiness (IR), industry support (IS), security concern (SC) and inter-organisation trust (TR) were insignificant. This research contributes to the limited empirical research literature in the blockchain technology adoption intention in academic libraries, while also provides the insights for practitioners in the technology adoption decision making, and technology vendors, in the context of developing countries.

Dedication

I dedicate this dissertation to my wife and our two boys who offered me their endless support and encouragement to keep focus and energy to complete the programme. These people make life meaningful to me in order to keep longing for more.

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My sincere gratitude goes the department of Information Systems at the University of Cape Town for affording me the opportunity to pursue my master's degree. Throughout the writing of my thesis, I have had a great deal of support.

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CHAPTER 1 : INTRODUCTION

1.1. Background

Academic libraries offer a wide range of services and resources from physical to electronic in order to fulfil their purpose of support to teaching, learning and research, with much focus on high quality services to meet their patrons' needs. Academic libraries strive to provide relevant resources to their clientele in a timely manner. Therefore, it is of great importance to the academic libraries how this information is being used by the communities they serve, especially where value for money invested, matters (Kasemsap, 2017). However, due to the rapid changes in digital technology, user requirements, and budget cuts, academic libraries are facing challenges around the globe to meet the information seeking behaviour of their patrons. This situation forces them to become innovative, cooperate with the stakeholders, re-engineer their business processes and adapt to the increasingly changing market sphere of information to tackle these challenges competitively (Kasemsap, 2017; Prybila, Schulte, Hochreiner & Weber, 2020). Library information systems that automate and execute library processes have been used extensively within individual institutions to achieve their objectives (Mendling et al., 2018). However, when these processes have to be integrated across independent institutions, it becomes a challenge because of lack of trust between the involved parties in terms of coordination of collaborative business processes (Weber, Xu, Riveret, Governatori, Ponomarev & Mendling, 2016).

Academic libraries are not an exception to this challenge of control. According to Wilding (2002), libraries get along smoothly with different types of partnerships due to the long history of collaboration culture they have. The rapid growth of the library partnerships is through consortia establishment, but libraries still depend on a third party to facilitate their collaborative activities, and consequently incur costs for coordination of such processes (Alharrasi and Al-Aufi, 2012). This triggers the need for a decentralised platform to address these challenges of control controversy, mediation costs and interoperability of the internal systems (Weber et al., 2016).

Emerging blockchain technology with its distributed nature (Milani & Garcia-Banuelos, 2018), peer to peer transmission, traceability, immutability and logic programming, may come in as the solution for inter-library processes to be conducted on a shared platform without central authority (Fridgen, Radszuwill, Urbach & Utz, 2018). Blockchain is essentially a distributed database (Crosby, Pattanayak, Verma & Kalyanaraman, 2016) whereby participants share immutable records (transactional data) chained into time stamped blocks across the whole blockchain network partners (Weber et al., 2016). This fits well with the library work of creation, gathering, preservation, and sharing of knowledge which should remain easily accessible to patrons for a very long time. However, provision of permanent access to digital content produced by academic institutions still remains a challenge to the academic libraries due to lack of proper digital preservation systems (Masenya & Ngulube, 2021).

Despite the growing interest and relevance of blockchain for both practitioners and researchers, the intention to adopt blockchain technology to innovate academic libraries business processes is not known in the whole African continent. This study will investigate the intent to adopt blockchain technology for collaborative business processes across academic libraries in the South African context. The focus is on obtaining influencing inter-organisational factors on intention to adopt, perceptions, and applications of blockchain technology from various perspectives at the organisational level as opposed to individual level.

1.2. Problem statement

Academic libraries are characterised with creation, gathering, preservation, and sharing of knowledge which should remain easily accessible to patrons for a very long time (Masenya & Ngulube, 2021; Matthew, 2017). However, provision of permanent access to digital content produced by academic institutions still remains a challenge to the academic libraries due to lack of proper digital preservation systems (Masenya & Ngulube, 2021).

Over the recent years, digitalisation phenomenon has forced many institutions, including libraries, to change their business models by leveraging digital innovations that present new capabilities and novel opportunities in their competitive working environments (Iwu-James, Haliso & Ifijeh, 2020). Moreover, according to Brundy (2015), in the last half of 20th century, many researchers and practitioners encouraged academic libraries to radically change to stay relevant since innovation and collaboration were not choices anymore, but necessities. However, Cabello, Janßen and Mühle (2017) noted that even though academic libraries were characterised by long history of collaboration, they have been slow adopters of new technologies in their business processes. In a case where automation systems have been adopted, they operate in silos, which results in duplication of effort among academic libraries. This as a result negatively impacts their performance.

Lack of integration of business processes across independent institutions is normally caused by lack of trust among the involved parties in terms of coordination of collaborative processes (Weber et al., 2016). However, to enable automation of these collaborative activities, a central authority is normally involved for coordination, which attracts costs and introduces a single point of failure risk.

Emergence of blockchain technology with its distributed nature (Milani & Garcia-Banuelos, 2018), peer to peer transmission, traceability, immutability and logic programming, may come in as the solution for inter-library processes to be conducted on a shared platform without central authority (Fridgen et al., 2018). Yet, while studies on blockchain, among other emerging technologies, have gained a relative pace over the recent years, there is no sufficient literature that reports research cases on blockchain adoption in the library and information profession. Academic libraries, therefore, should not stay behind lest they become obsolete and outcompeted by other information rivals. To the best of the researcher's knowledge, no empirical study that has been carried out on blockchain adoption in the context of academic libraries, hence the motivation for this study.

1.3. Research question

Since blockchain technology development is still at its infancy stage, few applications are already in use, others are proof-of-concepts and many have been theorised without being fully put into practice (Dolan, Kavanaugh, Korinek & Sandler, 2019). Therefore, the possibilities of blockchain applications in the library and information services have to be considered, hence the following question:

"Why academic libraries intend to adopt blockchain technology for their collaborative business processes in South Africa?"

1.3.1. Sub-questions:

1. What are the potential applications of blockchain in academic libraries?
2. What are the academic libraries' perceptions of intention to adopt blockchain?
3. What are the academic libraries' perceptions of blockchain technology adoption factors?
4. What are the factors that influence the intention to adopt blockchain technology for academic library collaborative processes?

1.4. Research objectives

1. Explore the potential applications of blockchain technology in academic libraries.
2. Explore the perceptions of intetion to adopt blockchain.
3. Explore the perceptions of blockchain technology adoption factors.
4. Explore the key factors which influence the intention to adopt blockchain for inter-library processes.

1.5. Significance of the study

The aim of the study was to investigate the intention to adopt blockchain technology for collaborative business processes across South African academic libraries. In doing that, the study draws on the Technology Adoption in Supply Chain (TASC) model, which is an extension of the Technology-Organisation-Environment (TOE) framework (Asare, Brashear-Alejandro & Kang, 2016). Considering limited literature on blockchain application in academic libraries, the findings of this research could contribute to the body of knowledge which is very scarce regarding blockchain adoption in the developing economies. To the researchers in the field, the study could serve as the basis for further knowledge development, especially in the developing country context, such as South Africa. This study further provides deeper insights regarding perceptions of the academic library professionals on the intention to adopt blockchain, influencing factors, and use cases to be considered when adopting blockchain in the academic library sector. This could be valuable to the academic libraries in their strategic decision making, especially where disintermediation of collaborative business processes is very crucial.

1.6. Dissertation overview

The next chapter contains relevant literature review for the study, followed by theoretical background, and the conceptual framework that was used as a lens to answer the questions formulated in this study. The research design, and methodology followed in conducting this research are discussed in Chapter 3. Chapter 4 presents the preparation of data for analysis, results of the analysis, the research findings according to the data collected, and the discussion of the findings. Lastly, concluding remarks, together with study implications, limitations were presented with recommendations for future research in Chapter 5.

CHAPTER 2 : LITERATURE REVIEW

2.1. Introduction

Globalisation has compelled businesses and institutions to leverage digital innovations that present new capabilities and novel opportunities because of the stiff competition in their operating environments (Iwu-James et al., 2020). In this digital era, academic libraries, like any other institution are compelled to re-think of their ways of providing library and information services to remain relevant to the academic communities they serve as there are various other sources of information which attract users' attention (Cabello et al., 2017; Iwu-James et al., 2020). Although libraries may still remain the major sources of academic information, they have to re-strategise and adopt new ways to accommodate flexibility and remain in business (Holotiuk & Moormann, 2018). As a result, according to Brundy (2015), in the last half of 20th century, many researchers and practitioners maintained that academic libraries should radically change in order to stay relevant since innovation and collaboration were not choices anymore but necessities. However, Cabello et al. (2017) noted that, libraries have been slow adopters of new technologies in their business processes. This is exemplified by the procedure that is still followed to borrow books which comes from several decades ago. They further iterate that, patrons from the libraries in partnership should do multiple registrations to be able to borrow items or get access to resources from a different library with cooperation agreement, because of lack of integrated systems for information exchange. Nevertheless, in the last few decades, academic libraries' main aspect of change has been new technology adoption worldwide, which is reflected by a vast literature about new technologies in libraries (Al-Fadhli, Corrall, & Cox, 2016).

Different university libraries experience common problems and pressures which are mostly too complex and large to handle on their own (Atkinson, 2019). Because of the growing demand of information services (Alharrasi & Alhijji, 2015), declining budgets, rapidly changing world around academic libraries (Atkinson, 2019) and increase in prices, library consortia were formed in developing and developed countries (Cuhadar & Cimen, 2019). Sharing of resources and expertise was the mandate of consortia formation. In order to achieve their mandate, enabling collaborative technologies to integrate internal systems, should be adopted to eliminate duplication of efforts, free up time for more important activities and improve service delivery (Atkinson, 2019). Backed up by Bedin, Capretz and Mir's (2020) view, any situation that requires high level of trust among cooperating parties or a third-party intermediation to validate interaction, can reap benefits from using blockchain technology trusted environment. Moreover, social media, mobile technologies and their related applications are rapidly evolving, which impact on how, where and when academic libraries provide services to their clients (Atkinson, 2019; Masenya & Ngulube, 2021). The lockdown induced by COVID-19 pandemic, forced most employees to work from home and only use technology to serve their patrons and maintain relationship virtually. It is, therefore, necessary to understand new technology adoption and diffusion factors that should be taken into consideration to prepare for situations like this one where reliance on technology is forced (Magsamen-Conrad & Dillon, 2020).

Blockchain represents one of the disruptive technologies with potential to streamline the collaborative activities across academic libraries (Cabello et al., 2017; Holotiuk & Moormann, 2018), especially with the assertion made by Ayre and Craner (2019), Cuhadar and Cimen, (2019), and Atkinson (2019) that sharing has become a core value in the library world because of the interlibrary loan, reciprocal borrowing, resource sharing, open access initiative, joint procurement, ORCiD implementation and many others. Seamless information exchange between different institutions facilitated by inter-organisational systems enables efficiency and transaction monitoring capabilities. With blockchain technology capabilities to enable network members to securely interact or transact directly with one another without central authority, extra costs for administration of shared resources can be eliminated (Werner, Basalla, Schneider, Hays, & Vom Brocke, 2021). However, blockchain is not a panacea for all problems of information management, therefore critical assessment and evaluation have to be considered before the implementation stage (Ayre & Craner, 2019).

In this section, a literature review of blockchain technology adoption in the library and information profession, is undertaken. This gives an overview of blockchain, applications and factors that influence blockchain technology adoption in academic libraries, which serves as the base for researchers to develop the current knowledge further and helps practitioners with strategic decision making when intending to adopt this technology. The intention to adopt blockchain technology across academic libraries' business processes in South Africa is not known, which is the gap intended to be addressed by this study.

2.2. Literature search

As blockchain technology is among the emerging technologies, and academic libraries technology adoption being continuously evolving, peer-reviewed journal articles and conference papers were the main sources of information for this study as they contain the most up-to-date information. The main keywords used included blockchain technology adoption, blockchain services, technology adoption in academic libraries, smart technology libraries, South African academic libraries, collaborative business processes in academic libraries, academic library consortium, and blockchain adoption in libraries. The scope of the research papers or journal article was within six -year period (2015 to 2021) to cover the most recent aspect of the search topics. The search engines which were mostly used are Google, Google Scholar and University of Cape Town (UCT) Libraries' electronic databases searches. Databases which were mostly searched through UCT Libraries were IEEE Explore Digital Library, ACM Digital Library, Web of Science, Emerald, Science Direct, Scopus, EBSCOHost, JSTOR, Taylor and Francis, and SAGE.

2.3. Blockchain technology overview

Blockchain technology application was first realised in a famous cryptocurrency, Bitcoin in 2009 which caught the attention of both practitioners and researchers (Fridgen et al., 2018; Viriyasitavat, Da Xu, Bi & Sapsomboon, 2018). Blockchain was defined by Viriyasitavat et al. (2018) as the distributed digital ledger of transactions immutably recorded in an auditable chain of time stamped blocks maintained by all participating nodes. The completed transactions get updated on the ledger through consensus of the majority in the network, which eliminates central authority requirement. Each block in this chain has the information about the previously added block as shown in Figure 1, and the link between the blocks is achieved by applying cryptographic algorithms. This makes it difficult for any modification or deletion to occur after the approval of data by the participating nodes (Fridgen et al., 2018). Mendling et al. (2018) posit that the innovative power of this technology comes from permitting untrusted parties to transact in a peer-to-peer network of computers enabled by consensus algorithms, cryptography and market mechanisms. Trustworthiness stems from the blockchain software and the incentive mechanisms used for the participating nodes in the blockchain network (Rimba et al., 2020). When the new block is appended to the chain, it is signed using asymmetric keys, and in this way the contents such as timestamp, previous block hash value and transaction data (Sawa, 2019) of the block can be checked whether they match block's signature to ensure they are not tampered with (Mendling et al., 2018).

The consensus algorithm used for well-established cryptocurrency; bitcoin, is Proof of Work (PoW). This is whereby one has to find a number called nonce, such that hash value associated with the transaction data complies with certain conditions. This computation process is called mining and it requires a lot of energy. In order to modify data in the block, one has to find nonces for the preceding blocks to change hash values which is a very difficult task, especially when there is a long chain of blocks linked together already (Sawa, 2019).

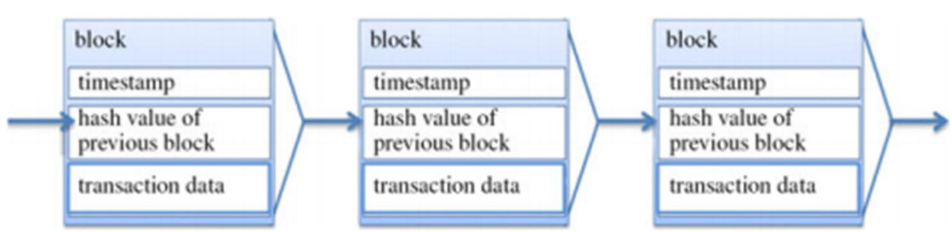

Figure 1. Conceptual diagram of blockchain (Sawa, 2019)

Blockchain offers another innovative concept that is very crucial for business processes, called smart contracts (Mendling at al., 2018) with modified consensus protocol, which García-Bañuelos, Ponomarev, Dumas and Weber (2017), and Lu (2019) consider as the second generation of blockchain (blockchain 2.0), whereas cryptocurrency blockchain is referred to as the first generation (blockchain 1.0). Smart contracts are user-defined 'self-executing scripts' stored on the blockchain network, that execute the terms of the contract (Werner et al., 2021). That is, business processes are subjected to rules which have to be executed when certain conditions have been met (Mendling et al., 2018). These business rules can be automated using smart contracts in inter-library business processes on a shared, secure blockchain platform. By doing so, trusted intermediates are eliminated, and erroneous and accidental transactions are minimised (Bedin et al., 2020). Smart contracts can also be incorporated and run as part of the transactions in a block by the connected nodes in the peer-to-peer network (Werner et al., 2020). Ethereum being the most dominating blockchain platform on which smart contracts execute (Rimba et al., 2020), has built-in Turing-complete scripting language for smart contracts called Solidity. The executing environment (Ethereum Virtual Machine (EVM)) for bytecode compiled from Solidity, has all the participating nodes in the blockchain network. This is further confirmed by García-Bañuelos et al. (2017) that correct execution of the scripts is guaranteed by protocols used on the Ethereum blockchain platform. It is through smart contracts that 'real-world logic' can be implemented in blockchain technology (Lu, 2019). Blockchain is classified as a digital innovation because of its impact on products, processes, and business models, just like other digital innovations, though many industries are still exploring it (Holotiuk & Moormann, 2018). With its capabilities, blockchain can be used as the interoperable digital preservation platform that facilitates information sharing for a long period of time. Figure 2 shows how blockchain platform connects different organisations for collaborative business processes, whereby clients' records are shared among the participating organisations.

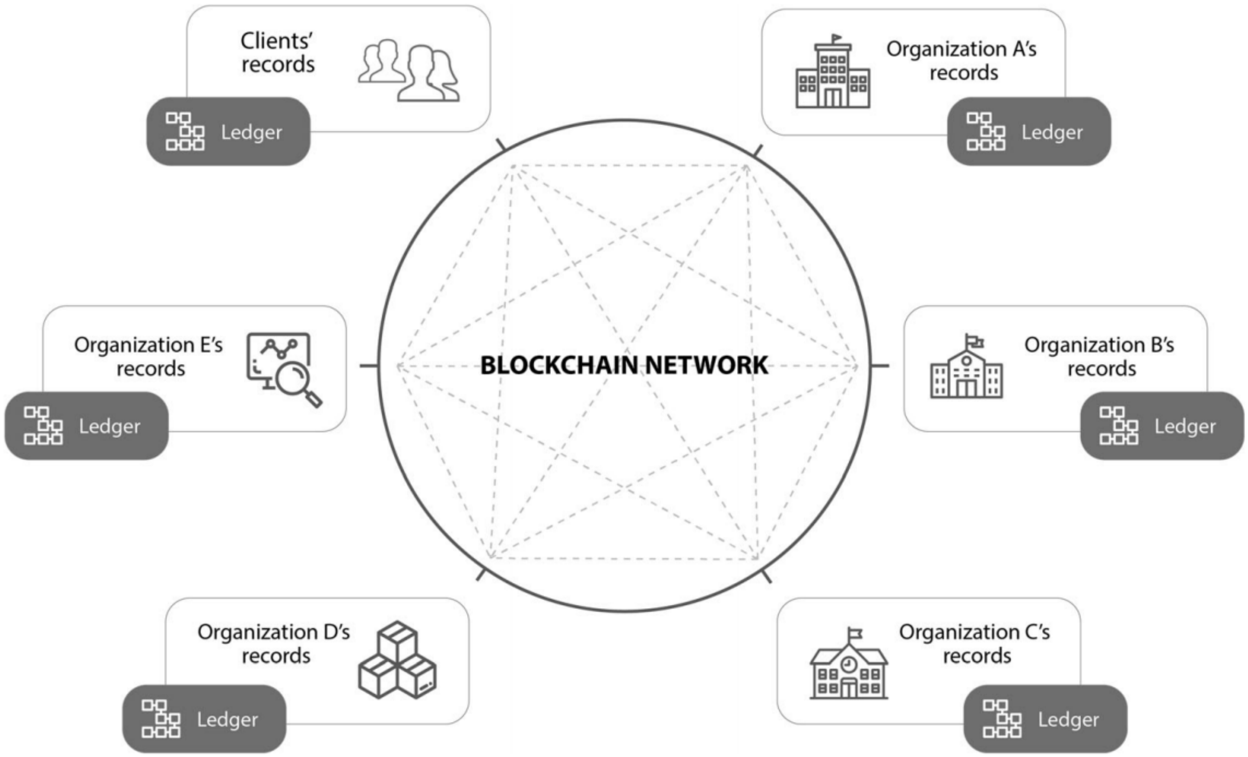

Figure 2. Blockchain platform for collaborative business processes (Bedin at al., 2020)

2.3.1. Types of blockchain

Blockchain technology has different types which are categorised based on openness to their network and validation processes of transactions, with different features and vulnerabilities. Therefore, different considerations have to be taken care of in terms of regulations and security towards each type (Ducas & Wilner, 2017). There are currently three types, namely, public (permissionless), private (permissioned) and consortium (hybrid) blockchains (Zheng et al., 2017).

Public blockchain

Public blockchain protocols are open-source and classified as permissionless because anyone can freely and unconditionally participate in the consensus process, verify, write and read transactions with pseudonymous identities (Makhdoom, Abolhasan, Abbas & Ni, 2019; Zheng et al., 2017) and get corresponding incentives based on the contribution made (Lu, 2019). Public blockchain was the first to appear and spread to different disciplines. Bitcoin and Ethereum are examples in this type (Lu, 2019).

Private (permissioned) blockchain

Private blockchain is a permissioned digital ledger whereby control is fully on one organisation with only a limited number of participants with known identities, that can join the consensus process (Makhdoom et al., 2019). It is somehow found to contradict with decentralised nature of blockchain technology, though resilience to attacks and transparency are still kept (Savelyev, 2018). Moreover, users may have access to only transactions directly related to them. For example, Hyperledger-fabric allows competing businesses to maintain their transaction privacy and confidentiality through private channels on the same platform (Makhdoom et al., 2019).

Consortium blockchain

Because of inheritance of public and private blockchains' characteristics, consortium blockchain is also called hybrid blockchain (Makhdoom et al., 2019). This type operates under the coordination of a group of organisations, and access to the network is only granted to the member institutions. The consensus process is between the pre-selected member nodes only (Zheng et al., 2017). Other nodes may get access to blockchain transactions only, without participation in the consensus process (Lu, 2019). As the participants in the consensus process are also restricted and given identities like in private blockchain, it is also called permissioned blockchain (Werner et al., 2020). This type can be suitable for collaborative network processes shown in Figure 2, such as academic libraries' consortia.

2.3.2. Consensus mechanisms

Consensus mechanisms are responsible for the integrity of the information in the blockchain without central authority, while preventing double-spend attacks by participants who do not necessarily trust each other (Reyna, Martín, Chen, Soler, & Díaz, 2018).

Proof-of-Work (PoW)

Any node in the blockchain network can participate in reading, writing, data validation and consensus process under PoW (Lu, 2018). All nodes compete to solve mathematical puzzle using their computational power to be able to create a new block. Once the puzzle has been solved, the solution is broadcast to the network and the newly created block gets verified and appended to the chain by all blockchain participants (Reyna et al., 2018). This is the most energy-intensive mechanism with slow transaction rates because all the nodes work on the same block racing for the first position and verification, and this makes it unsuitable for many applications (Lu, 2018; Reyna et al., 2018). However, it has been successfully used in public blockchain, Bitcoin miner nodes are incentivised for verification (Reyna et al., 2018).

Proof-of-Stake (PoS)

In PoS, priority to mine a new block is given to the node with the highest stake in the network because it is less prone to attacks than those with less stake (Lu, 2018). This is based on the fact that those with more stake, are more interested in the proper functioning of the system, hence take responsibility for protecting the system (Reyna et al., 2018). This mechanism is energy-saving compared to PoW (Lu, 2018), though criticised for enriching the rich because it does not incentivise those who vote for the correct block to be appended (Reyna et al., 2018).

Practical Byzantine Fault Tolerance (PBFT)

PBFT algorithm is based on state machine replication to tolerate byzantine faults (Lu, 2018). Replicas are compared for consistency to be appended to the chain. Even if there are faulty nodes (respond with inconsistent information), the collective agreement is made upon the same value to avoid system failures. This mechanism is used in permissioned blockchains where number of participants is usually lower than in public blockchains, and have predefined permissions (Reyna et al., 2018).

2.4. Potential applications of blockchain in academic libraries

Blockchain technology has captured the attention of many countries and industries, with financial industry taking the lead (Deloitte, 2021). The largest financial blockchain consortium, R3 CEV has launched its first blockchain-based system for banking and financial institutions (Lu, 2019). The South African reserve bank released a report that shows positive results in blockchain trial for interbank electronic payments. As a result, this may catalyse the blockchain adoption in the use cases of other industries (Antonysamy, 2019). The Canadian government has implemented blockchain system that tracks cannabis production from 'seed-to-sale' to reduce regulatory costs, protect public safety and weaken illegal markets (Lu, 2019). In this section, potential applications of blockchain technology in the library and information sector are discussed.

2.4.1. Provenance of digital content

Many institutions of higher learning and research evaluate their researchers' performance based on the number and quality of publications associated with the conference proceeding name, journal name, impact factor or conference rating, and whether single authored or co-authored. With this method, it is difficult to prove the extent of content contribution of the claimed author, co-authors, and non-authors (research assistants, for example), who might have contributed yet they have been excluded from the author list. Co-authors are normally considered to have contributed equally to the paper which is not always the case. One may claim to have made contribution, especially if he or she is a senior researcher. The proof-of-work contributed by the listed authors cannot be achieved using the current metrics used to measure author performance (Mohd Pozi et al., 2018).

With the use of traceability inherent in blockchain technology, authorship contribution to a publication can be proven. Revisions of a paper by each author are logged at the user level, and at certain count of revisions made, they will be cryptographically recorded on blockchain until the paper is finalised (Mohd Pozi et al., 2018). This improves provenance traceability and can change people's perceptions about intellectual property that concerns digital objects (Ayre & Craner, 2019). In addition to this, integrity of the document digitally stored on blockchain will be preserved for continuous access to the resource because of blockchain distributed nature and immutability (Mohd Pozi et al., 2018).

2.4.2. Bibliographical metadata

Because of the distributed nature of blockchain, libraries can use it for distributed metadata system whereby every library can access data without the central authority. This will eliminate costs which are currently incurred by using Online Computer Library Centre (OCLC) for metadata of items hosted by different organisations worldwide. The blockchain system will scale well while outputting quality metadata based on hashing (Rubel, 2019). Ayre and Craner (2019) note that Jason Griffey who is a librarian and a technologist, believes that distributed systems such as blockchain-based systems, are in line with the library value; to serve customer interests without single point of failure.

Huwe (2019) supports the metadata services application identified by San Jose State University (SJSU) iSchool project team as the starting point since experimentation with this use case is unlikely to cause any harm to users in terms of personal data being at risk. He further states that this move may trigger large academic libraries and commercial partners, OCLC for example, to provide required expertise and resources to improve on metadata operations which will result in timesaving for librarians and information professionals.

2.4.3. Copyright management

There is currently lack of central storage for information about copyright owners of the copyrightable materials which are recorded on different database systems by different companies: publishers, record companies and other entities. This obscures transparency, and it is timely and financially costly for users who are interested in such digital content to get access, which may lead to non-usage because of unclear legal status. These issues may be to a certain extent attributed to the use of expensive proprietary technologies which are not interoperable with one another, hence data sharing becomes difficult (Savelyev, 2018). With blockchain technology, standardization and network effects in the copyright management can be achieved (Savelyev, 2018).

2.4.4. Digital first sale

For centuries, contracts have been deemed to be successful when parties do not disagree till the end. Otherwise, disagreements come after the injury has occurred. Authors are not exceptions to this scenario (Hammond, 2018). With the proposal of blockchain-based e-book platform from DECENT that will allow self-publishing, digital first sale rights can be protected by implementing blockchain-based digital rights management (DRM) system using smart contracts and eliminate potential disputes between publishers and authors (Ayre & Craner, 2019; Coghill, 2018). Authors will have complete control in real time of how their digital assets can be accessed and used, and their pricing will no longer depend on the publishers. The aim of DECENT's proposal is to include reader-to-reader lending and direct author payments using cryptocurrency, which can benefit the libraries with low prices without publishers' commission (Ayre & Craner, 2019; Hammond, 2018).

2.4.5. Credentialing

According to Huwe (2019), the best way to decentralise services is to start by developing secure credentialing system that can be used for everyday personal needs. This will ensure proper use of resources as the unauthorised access will be well taken care of by the system through libraries as the top community service providers of blockchain services for cities, or even at the national level. Regardless of the library registered with, patrons can borrow, request an item from any participating library in the network or from user who borrowed the item from the partner library (Cabello et al., 2017). All libraries in consortia can handle interlibrary loans, patron authentication and collection management by using blockchain system, hence eliminating existing data silos. However, much research should be done to investigate blockchain applications in the library and information profession (Ayre & Craner, 2019). The exercise will go beyond identity card to gain access to the services. The new vetting procedure which will incorporate extra coding expenses, will have to be employed (Huwe, 2019).

2.4.6. Library network connection

Coghill (2018) notes that any kind of information can be shared on blockchain technology which include patron information that can be shared between the libraries when there is a need, with sensitive information being encrypted on the blockchain platform. Libraries and universities can connect to form Inter-Planetary File System (IPFS) on blockchain and eliminate internet service providers and large internet companies as gatekeepers (Smith, 2019). IPFS is the Ethereum-based file transfer protocol that uses peer-to-peer file sharing.

However, in all these applications which may strike as good uses of blockchain technology, there is a need to assess personal data integrity risk that may be created and the worth of using new blockchain technology to avoid reinventing the technical operations which already work well. Under the current environment where personal data is widely shared, thorough review of new technologies have to be made before they can be deployed to replace or augment the existing platforms (Huwe, 2019).

2.5. Theoretical framework

Despite the vast opportunities offered by blockchain, it has some challenges like any other new technology, which many industries will keep facing as new use cases emerge (Grewal-Carr & Marshall, 2016). It is therefore meaningful to revisit the extant literature on blockchain, and other technologies adoption to understand the decision factors and their characteristics when organisations analyse their adoption, guided by theoretical framework. These factors encompass both hurdles and opportunities which collectively influence the manner in which organisations adopt new technologies (Hiran & Henten, 2020).

Information technology (IT) innovations are now part of every business because of their significant impact on organisations (Clohessy, Acton, & Rogers, 2019). Intention to adopt a technology innovation to respond to dynamic customer needs and manage multiple partnerships depends mostly on the capabilities of new technology, in particular collaborative technologies (Asare et al., 2016). Blockchain technology is one these disruptive technologies with potential to revolutionise all web-based information services in the library and information sector (Herther, 2018), and many other industries (Holotiuk & Moormann, 2018). There are existing studies on the adoption and use of blockchain technology, both on empirical and conceptual levels, but very few have focused on academic libraries.

Intention to adopt innovation is the willingness to engage in a positive behaviour by users towards an innovation. Since blockchain technology is still at its early stage of development, literature on its adoption behaviour is lacking, especially, in the context of the academic libraries. However, in some countries, especially western countries, blockchain adoption behaviour has been empirically tested in other industries such as supply chain (Alazab, Alhyari, Awajan & Abdallah, 2021). It is also postulated that, the more users employ technology in their activities to improve customer services, the higher the increase in intention to adopt such a technology (Alazab et al., 2021).

While there is vast literature on the new technology adoption (Clohessy, Acton & Rogers, 2019), very few studies focus on inter-organisational technology adoption (Werner et al., 2021). Much of the literature focuses on technology adoption theories at individual level such as Technology Acceptance Model (TAM) (Davis, 1989; Kabir & Islam, 2020), Theory of Planned Behaviour (TPB) (Awa, Ojiabo, & Emecheta, 2015; Lin, Chang, Chou, Chen, & Ruangkanjanases, 2021), Theory of Reasoned Action (TRA), Unified Theory of Acceptance and Use of Technology (UTAUT) and Innovation Diffusion Theory (IDT) (Maduku, Mpinganjira & Duh, 2016). UTAUT is based on TAM which is in turn rooted in both TPB and TRA (Arias-Oliva, Pelegrín-Borondo &

Matías-Clavero, 2019). IDT and TOE framework are mostly applied for adoption at organizational level, but they still borrow constructs from the individual technology adoption theories (Asare et al., 2016; Maduku et al., 2016).

In the current study, blockchain technology adoption intention is investigated at organisational level as an inter-organisational technology, where it is expected to have significant impact by facilitating data sharing and digital interactions between institutions, not for individuals to interact with online. This is because the most attractive and innovative applications of blockchain lie across the borders of individual institutions and sectors (Schaffers, 2018). Therefore, individual technology adoption theories were not suitable to be applied in this study. Technology adoption theories and frameworks considered for review in this study are IDT developed by Rogers in 1962, TOE framework proposed by DePietro, Wiarda and Fleischer in 1990 and Technology Adoption in Supply Chain (TASC) model proposed by Asare et al. in 2016. These theories have been briefly discussed in the sections below, followed by justification of the adapted framework for the current study.

2.5.1. Innovation Diffusion Theory (IDT)

The IDT was developed by Rogers in collaboration with Shoemaker in 1962 to explain the likelihood of how members of the social system adopt a new concept over time until adoption rate becomes self-sustaining, and creates further growth (Hiran & Henten, 2020). IDT has mostly been used by researchers both at individual and institutional technology adoption levels (Lai, 2017). IDT's five attributes (relative advantage, complexity, compatibility, trialability and observability) identified by Rogers in 1983, account for a significant variance in innovations adoption at organizational level, despite the efforts made by researchers to improve these attributes (Asare et al., 2016). However, only technology perspective is being considered by this theory, which is not enough for inter-organisational technology adoption study like blockchain.

2.5.2. Technology-Organisation-Environment (TOE) framework

The TOE framework was proposed by DePietro, Wiarda and Fleischer in 1990 and it is considered to have been derived from IDT. However, it comprehensively identifies and defines three perspectives that influence organisations to adopt new technologies (Hiran & Henten, 2020; Wong, Leong, Hew, Tan & Ooi, 2020). This framework has been empirically used to determine factors that influence technological innovations adoption at the organisational level in three contexts of technology, organisation, and environment to overpower IDT (Al-Hashedi, Arshad, Mohamed & Baharuddin, 2011; Maduku et al., 2016; Oliveira & Martins, 2011). This gives TOE advantage by providing holistic view of enterprise technology adoption in organisations as it combines both human and non-human factors in one framework (Wong, Tan, Lee, Ooi, & Sohal, 2020). It also provides the impact of the new technology on the current business processes, challenges, and opportunities of the technology under consideration (Gangwar, Date & Ramaswamy, 2015).

Wong, Leong et al. (2020) recently investigated the determinants of behavioural intention to adopt blockchain technology in operations and supply chain management by Malaysian SMEs using TOE framework. The findings revealed that relative advantage, complexity, cost, and competitive pressure were significant determinants of intention to adopt blockchain. Through integration of TOE-IDT frameworks, Hiran and Henten (2020) found technological, organisational, environmental, and socio-cultural factors to influence cloud computing adoption in Ethiopian Higher Education. Considering only organisational perspective, top management support, organisational readiness, and organisational support emerged as the significant blockchain adoption factors using TOE framework (Clohessy et al., 2019). Furthermore, Alshamaila, Papagiannidis, and Li (2013) established that relative advantage, uncertainty, geo-restriction, compatibility, trialability, organisational size, top management support, prior IT experience, innovativeness, industry support, market scope, supplier efforts and external computing support affect adoption of cloud adoption by SMEs in Northeast of England. However, TOE alone does not cover inter-organisational relationship factors which influence inter-organisational technology adoption (Esau & Seymour, 2019).

2.5.3. Technology Adoption in Supply Chain (TASC) framework

The Technology Adoption in Supply Chain (TASC) framework was proposed by Asare et al. in 2016 to identify determinants of inter-organisational technology adoption. The TASC model extends TOE by adding relationship perspective for inter-organisational adoption which addresses complexity of inter-organisational environment, of which TOE does not cover (Esau & Seymour, 2019). Four key determinants were identified by the TASC farmework: technology characteristics, organisational characteristics, external factors, and inter-organisational relationship.

Technology characteristics category has been found to account for a large amount of variance in inter-organisational technology adoption, and TASC borrows five IDT attributes with addition of cost, which is commonly not separated from relative advantage in inter-organisational technology adoption to make six variables (Asare et al., 2016). These are Relative Advantage, Compatibility, Complexity, Trialability, Observability and Cost. Organisation characteristics identified by TASC as important factors of technology adoption across different organisations, are Organisational Size, Management Support, Centralisation, and IT Readiness. External Environment is characterised by Environmental Uncertainty, Competitive Pressure, and Industry Support, whereas Inter-Organisational relationship variables are Power, Justice and Trust.

However, TASC has not been extensively tested empirically in technology adoption studies as it is still at its infancy stage. Esau and Seymour (2019) applied TASC in their study to investigate the implementation challenges of Radio Frequency Identification (RFID) technology in South African retail industry. Their findings revealed that most dominant technological challenges were "lack of proper readability and reliability testing" and "lack of justifying business case", while an organisational challenge was "lack of initial stakeholder involvement". The dominating environmental challenge was dependency on a single RFID vendor. Another inter-relation challenge was "Loss of small suppliers" who cannot meet the demands of the big retail shops, which aligns with power attribute under inter-organisational relationship variables.

2.5.4. Conceptual framework

For the purpose of this study, the TASC framework was adapted and contextualised as shown in Figure 3**.** In inter-organisational relationship factors, trust is another factor to be considered in this study as it has been identified as the key determinant of innovation adoption for inter-organisational technologies (Queiroz & Fosso-Wamba, 2019). Using the model proposed, the researcher was able to investigate constructs found to be relevant to study the intention to adopt blockchain technology across South African academic libraries. The four main categories are technology characteristics, organisational characteristics, external environment, and inter-organisational relationship with their respective constructs as shown in the Figure 3.

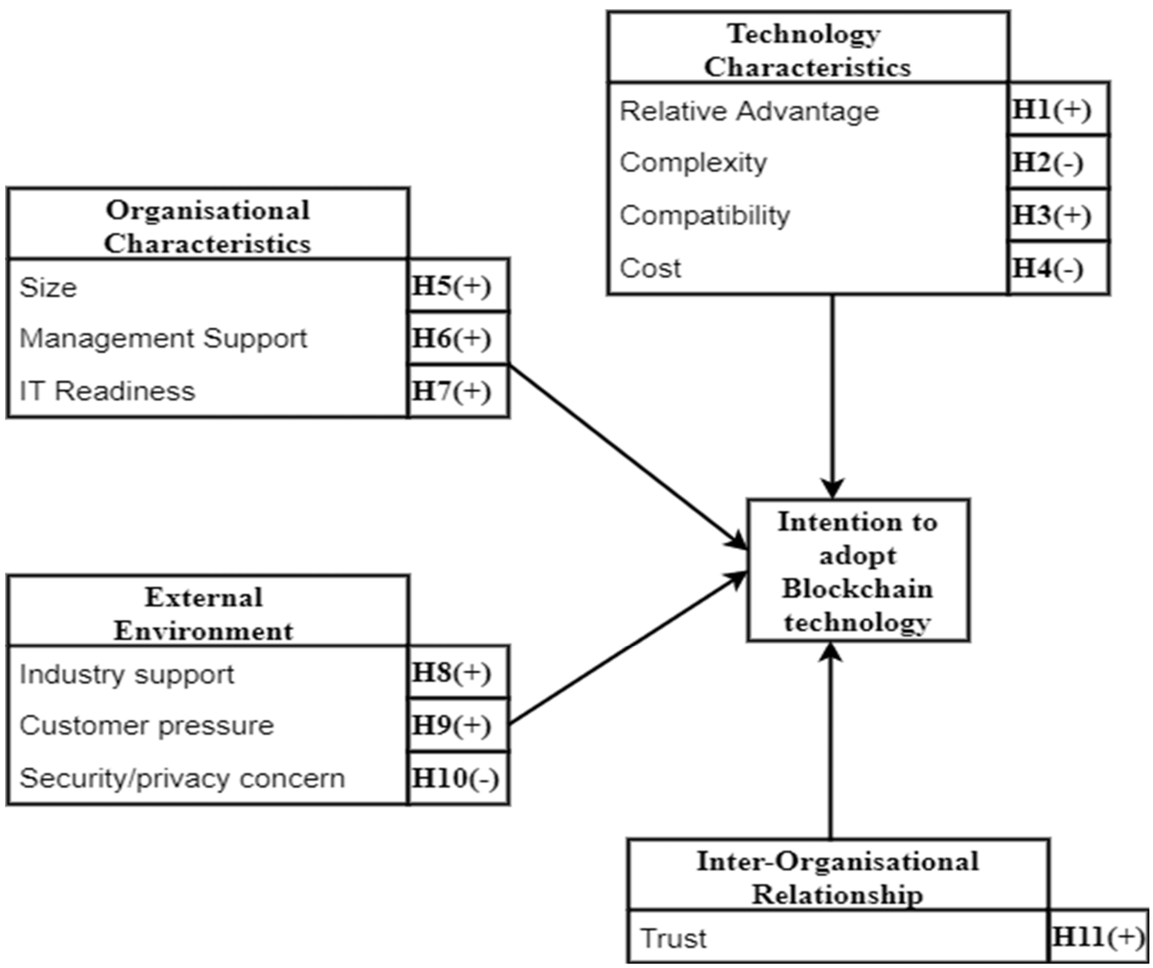

Figure 3. Conceptual framework (Adapted from Asare et al., 2016)

2.5.5. Technology characteristics

Technology characteristics refer to the technologies that are internal and external to organisation, including those which have not yet been used by the organisation. The adoption decision of these technologies is influenced by the perceived benefits which may be realised by using the technological innovation (Maduku et al., 2016). However, the need to maintain success with daily operations using the existing technological systems while adapting to new technological innovation is a challenge for many organisations (Holotiuk & Moormann, 2018). The proposed research model identifies four key attributes (relative advantage, complexity, compatibility, and cost) which are predominantly used in new technology adoption to determine the intention to adopt blockchain technology.

Relative advantage

Relative advantage refers to the extent to which technological innovation is perceived to be better than the one it replaces (Asare et al., 2016; Mustonen-Ollila & Lyytinen, 2003; Yang, Sun, Zhang & Wang, 2015). Maduku et al. (2016) argue that decision makers tend to adopt technology if they anticipate the benefits over the existing one, outweigh the risk of adoption and effort requirements for such technology adoption. Blockchain has raised high expectations for various industries to enhance their operations because of its decentralised status, and smart contract application (Alazab et al., 2021). Researchers in most of the literature of adoption have identified positive relationship between relative advantage and intention to adopt technology (Asare et al., 2016; Maduku et al., 2016). Therefore, it is hypothesised that:

H1: *The perceived relative advantage of the technology positively affects the intention to adopt blockchain technology.*

Complexity

Complexity refers to the extent to which technological innovation is found to be difficult to use (Yang et al., 2015). The extent to which potential adopters perceive the use of new technology to be easy, is found to positively influence the behavioural intention to adopt such technology (Maduku et al., 2016). However, if the technology is perceived to be difficult to understand, implement and use, it negatively influences the intention to adopt such technology. High complexity of technology confuses users, hence inability to understand and use such technology (Wong, Leong, et al., 2020). Complexity of the technology has been found to be negatively associated with intention to adopt the innovation (Asare et al., 2016). It is therefore hypothesised that:

H2: *The complexity of the technology negatively affects the intention to adopt blockchain technology.*

Compatibility

Compatibility refers to the extent to which technology is perceived to be consistent with organisational values (internal culture, business processes, management practices) (Asare et al., 2016), and compatible with the existing systems it is going to interface with for seamless communication (Gholami, Abdekhoda, & Gavgani, 2018). For any new technological innovation to be considered for adoption, it has to be compatible with the existing technology infrastructure and must fit the task it is proposed for (Ellis & Van Belle, 2009). However, technological integration is important yet a challenge in blockchain implementation, especially in this study context since multi-institution collaboration is involved, with different systems and technologies from different vendors. More effort will be required to simplify business processes and develop IT infrastructure before blockchain technology can be integrated (Kamble, Gunasekaran, Kumar, Belhadi, & Foropon, 2021). Since compatibility is positively associated with technology adoption, it is hypothesised that:

H3: *The compatibility of the technology positively affects the intention to adopt blockchain technology.*

Cost of innovation

Perceived cost of innovation may be direct and indirect. Direct cost refers to the actual price to be paid for acquisition of new technology, and indirect costs are the costs incurred when implementing, using, and maintaining the technology. High cost is a barrier to any product acquisition and negatively affects the adoption (Asare et al., 2016). Batubara et al. (2018) suggested that benefits of new technology should be higher than the cost of its development and maintenance.

In blockchain network, participating nodes require huge amounts of computing power and bandwidth to validate every transaction. That cannot be easily achieved using the current technology infrastructure (Min, 2019). Moreover, the efficiency of blockchain is achieved at the expense of high energy cost because all the nodes work on the same data at once which makes it difficult to adopt (Grewal-Carr & Marshall, 2016). With the ongoing research development, efforts to find a solution to these challenges are promising. For example, to overcome scalability issue, consensus mechanisms that minimise computational power requirements and transaction time significantly can be used (Batubara et al., 2018). Moreover, cloud-based blockchain as a service offered by technology companies can be deployed for experimentation with the library use cases.

However, Fedorov, Kiktenko and Lvovsky (2018) suggested that use of quantum technology for communication and computing will not only improve blockchain security but will enable blockchain to be faster and more cost efficient than the current verification and consensus processes. This will require quantum computers networked together for communication to form what is called quantum internet. Since quantum internet is some decades before it can be realised, 'blind quantum computation' can be the interim solution. Blind quantum computation is when conventional computer is used to remotely execute algorithm on a quantum computer on a public cloud quantum computing platform without sharing input data. This will result in cheaper and more accessible blockchains (Fedorov et al., 2018). Therefore, it is hypothesised that:

H4: *The cost of the technology negatively affects the intention to adopt blockchain technology.*

2.5.6. Organisational characteristics

Organisational characteristics refer to the attributes and the resources an organisation has which influence the intention to adopt innovation (Al-Hashedi et al., 2011). In order to stay competitive in the market, organisations have to emphasise on digital innovation adoption, which according to previous research, leads to new tasks and coordination methods. In essence, integrating more technologies to business processes shape the organisational behaviour since there is deviation from the existing, proven traditional innovations to develop new routines, beliefs and procedures, hence new identities (Holotiuk & Moormann, 2018). In the context of this study, organisational context is characterised by three constructs which include organisational size, management support and IT readiness because they are frequently found to influence the adoption of technological innovations.

Organisational size

Large organisations are believed to have a higher likelihood of adopting new technologies because of higher capacity than small organisations (Lin, 2014). Small organisations are constrained by lack of required expertise and insufficient budget, which are readily available in large organisations to enable IT innovation adoption (Clohessy & Acton, 2019). However, Asare et al. (2016) argue that organisational size has been both negatively and positively associated with intention to adopt new technology, but positive influence is dominating in the literature. Therefore, more reason to establish consistency in the relationship between organisational size and blockchain technology adoption intention. Blockchain technology requires technical expertise and for this reason, large organisations are likely to have the required expertise and financial resources (Lin, 2014). Therefore, it is hypothesised that:

H5: *The size of the organisation positively affects the intention to adopt blockchain technology.*

Management support

Management support refers to the commitment and perceptions by top managers towards the new technology adoption whether it will add value or not to the organisation (Gholami et al., 2018). This support is important especially for inter-organisational technologies because they are expensive and complex, and they require long-term vision, integration of resources for information exchange, and development of new skills among the partner institutions (Asare et al., 2016; Clohessy & Acton, 2019). There is a need for recognition, support and buy-in from the management of the university for collaborative activities to be successful (Atkinson, 2019). It is therefore hypothesised that:

H6: *The management support of the new technology positively affects the intention to adopt blockchain technology.*

IT Readiness

The information technology readiness of the organisation refers to the level of IT management complexity in an organisation (Asare et al., 2016) and likelihood of people with different skillsets to embrace and use new technologies to achieve their business goals (Atkinson, 2019; Lai, 2017). Many studies (Lai, 2017; Wong, Tan et al., 2020) further noted IT readiness as an essential factor because of conversion cost and interoperability with existing systems and technologies, to determine the technology implementation success. Organisations with complex IT infrastructure are more likely to have the required expertise and resources to adopt new technologies than those organisations with less complex IT infrastructure (Asare et al., 2016). Employees with the understanding of the resources available to support blockchain in this case, influence the intention to adopt blockchain for their records management. Technology awareness has been identified as the catalyst of adoption, although in Southern Africa, information professionals are struggling to keep abreast with technology evolution for proper records management (Mosweu & Chaterera-Zambuko, 2021). Atkinson (2019) notes that carrying out activities at an early stage that help participants understand their roles and issues around the technology adoption, is very important. In previous literature, IT readiness has been identified to positively influence the adoption and use of the new technology (Asare et al., 2016). However, there is scarcity of empirical studies that confirm the relationship with blockchain technology. In this study context, IT readiness is defined as the presence of IT expertise and infrastructure on which blockchain applications can be run. It is therefore hypothesised that:

H7: *IT readiness positively affects the intention to adopt blockchain technology.*

2.5.7. External environment

External environment refers to the factors external to the organisation but have an impact on organisational performance, and it has been consistently found to impact technology adoption at organisational level (Asare et al., 2016). Since blockchain technology is an inter-organisational system that facilitates exchange of information beyond organisational boundaries, environmental context is crucial to consider as it affects decision to transition to a common system (Gökalp, Gökalp & Çoban, 2020). According to the proposed research model, industry support, customer pressure, and security and privacy concern have been identified as the key external forces that affect blockchain technology adoption intention.

Industry support

Industry support refers to support from the associations in the sector, availability of established industry standards which are aimed at promoting and managing new technologies. Associations normally organise workshops to train staff and provide technology infrastructure for members (Asare et al., 2016; Maduku et al., 2016).

From technological point of view, when institutions are piloting blockchain technology for their business processes, they do not follow common guiding standards, processes and protocols. For example, some use Hyperledger while others use Ethereum with different standards and protocols (Antonysamy, 2019) which defeats the idea of being a distributed peer to peer network (Grewal-Carr & Marshall, 2016). However, Lu (2019) notes that Technical Committee and Standards for blockchains ISO/TC 307 has been formed by the global Blockchain Alliance Committee, and International Organisation for Standardisation (ISO), which will guide the ongoing development of blockchain technology with standards. Through these initiatives, organisations feel empowered to adopt new technology (Asare et al., 2016; Maduku et al., 2016). Because of the positive association between industry support and technology adoption, it is hypothesised that:

H8: *Industry support of the new technology positively affects the intention to adopt blockchain technology.*

Customer pressure

Customer pressure refers to persuasion and encouragement coming from the customers to adopt a certain innovation to meet their high expectations, otherwise organisations lose relevance to the customer (Holotiuk & Moormann, 2018; Maduku et al., 2016). It has been found that innovation adoption is driven by meeting customer needs electronically for better communications (Maduku et al., 2016). In the study context, libraries will be forced to adopt new technology if they believe that it will help them to effectively and efficiently deliver their services to their patrons. Therefore, it is hypothesised that:

H9: *The customer pressure positively affects the intention to adopt blockchain technology.*

Security and privacy concern

Security and privacy concern in this study refers to the degree of concern to data security and privacy regulations compliance in adoption of blockchain technology. Initially data protection act was enacted based on the structured relational data which is easy to manage and comply with (Salleh & Janczewski, 2016). With blockchain by design, data confidentiality may not be achieved

(Carminati, Ferrari & Rondanini, 2018). As a result, organisations may be reluctant to adopt blockchain technology in the absence of the comprehensive regulatory framework (Salleh & Janczewski, 2016).

However, blockchain supporters argue that regulating blockchain at this infancy stage will be a counterproductive move. As a result, regulators should rather find ways to accommodate new approaches within the existing frameworks as regulations at this stage will suppress innovation (Yeoh, 2017). On the other hand, state interests are threatened because blockchain systems cannot provide other critical security guarantees provided by the conventional law, other than transactional security (Yeung, 2019). "The European Parliament voted to adopt a smart regulatory hands-off approach to regulating blockchain technology" (Yeoh, 2017, p. 203). Moreover, in their G20 meeting, Argentina, Australia, South Africa, Turkey and United Kingdom decided not to regulate blockchain as yet (Duy et al., 2018). Other than this controversy of blockchain regulatory framework, governments around the world recognize the value of blockchain technology (Duy et al., 2018; Yeoh, 2017).

From technology perspective, security and privacy are very important in information systems. In public blockchain such as Bitcoin, pseudonyms are used instead of real identities by participating nodes (Viriyasitavat et al., 2018). On the contrary, many potential blockchain applications depend on smart contracts which require real identities of the participants. This process raises concern in terms of security and privacy of the shared data on blockchain (Grewal-Carr & Marshall, 2016). Therefore, public blockchain is not suitable for applications with participation requirements or restricted privacy (Duy et al., 2018). Trying to solve the problem of privacy, Corda, which is a permissioned blockchain-based enterprise platform, was released by R3 to verify users and keep their information encrypted and secure on the platform (Woodside, Augustine Jr & Giberson, 2017). Even though encryption in the distributed blockchain technology has never been broken since 2009 when its first application was realised, some scholars still believe that there is no technology that is secure in its entirety (Grewal-Carr & Marshall, 2016). Fedorov et al. (2018) argue that blockchain security currently relies on one-way mathematical functions that are used to generate digital signatures and validate transaction history. With the development of quantum computers, there is prediction that in ten years' time, quantum computers will be able to break widely used one-way encryption in blockchain technology, which will render the encryption obsolete. Anyone equipped with quantum computer will be able to break and forge digital signatures, and appropriate users' digital assets (Fedorov et al., 2018).

The solution to the security challenge is to replace the classical digital signatures with the quantum cryptography in blockchain network. However, quantum cryptography networks adoption may be delayed because of their cost and complexity (Fedorov et al., 2018).

It is therefore hypothesised that:

H10: *Security and privacy regulatory concern negatively affects the intention to adopt blockchain technology*

2.5.8. Inter-organisational relationships

The relationship between collaborating partners is very important as it will be easy for partners to subscribe to a certain collaborative technology to streamline their operations, especially when they involve information sharing (Queiroz & Fosso-Wamba, 2019). Libraries are characterised by multiple relationships which require proper coordination tools to support their interaction because of the level of complexity involved (Ibegwam, Unobe, & Uzohue, 2019). An inter-organisational trust variable is the one to be tested in the context of the academic libraries because it has been considered to be significant in inter-organisational relationships as it reduces perceived risk in collaborative processes (Liu, Ke, Wei, & Hua, 2015).

Inter-organisational trust

Trust refers to willingness of two or more institutions in partnership to rely on one another to benefit from their partnership (Queiroz & Wamba, 2019). Trust is established when one party believes that another partner has honesty, skill and knowledge related to a particular task which is motivated by the joint gains (Asare et al., 2016). Trust is very important in inter-organisational technologies because the collaboration involves sharing and access of confidential information (Asare et al., 2016; Queiroz & Wamba, 2019). Trust in collaborative relationship reduces perceived risk between partners. So, without trust and openness, partners are reluctant to adopt shared technologies to realise considerable benefits for their libraries (Atkinson, 2019; Liu et al., 2015). Libraries' major reasons for collaboration are cost reduction and resource sharing to improve service delivery to their clients (Ibegwam et al., 2019). Blockchain is currently found to be the viable solution to minimise cost, uncertainty, bring transparency and improve level of trust among the network members to improve on performance (Queiroz & Wamba, 2019). Therefore, it is hypothesised that:

H11: *The level of trust between partners positively affects the intention to adopt blockchain technology.*

2.6. Chapter summary

Though academic libraries are characterised by a long history of collaboration, integration of their internal systems to facilitate information exchange is still a major challenge. This results in duplication of effort among the academic libraries, which negatively affects their performance and users' satisfaction. In cases, where there is coordination of collaborative activities, a third party is involved as the central authority, which attracts extra costs, and introduces a single point of failure risk for the concerned parties. Moreover, academic libraries are still challenged by lack of proper digital preservation systems that can provide permanent access to digital content produced by academic institutions.

This necessitates the academic libraries to rethink their strategy in offering their services at minimal costs with the leverage of IT-innovation. Moreover, IT has been found to make life easy and remedy the situations where movement restrictions are induced, and the only way to communicate and keep relationship with clients is through technology use. Blockchain technology adoption studies have been undertaken in different sectors; financial sector, and supply chain taking the lead (Deloitte, 2021). However, studies in blockchain for academic libraries that have been reviewed, are of the conceptual nature. To the best of the researcher's knowledge, no empirical study that has been carried out about blockchain adoption in the context of academic libraries. Blockchain is a nascent technology that captured the attention of different industries because of its features and potential to disrupt products, processes and business models. Academic libraries therefore should not stay behind lest they become obsolete and outcompeted by other information providers. This therefore presents opportunities for researchers to explore blockchain technology adoption and use in this area.

It is confirmed that technological factors are dominating other contexts in the current literature review of inter-organisational technology adoption. Where the TASC framework has been empirically tested by Esau and Seymour (2019), lack of trialability, justifying business case and stakeholder involvement were found to be technology implementation challenges in the South African context. Therefore, academic libraries need to know how blockchain technology could affect their business processes by considering its properties to assess the appropriateness of the technology to address their current challenges. While proof of concept needs to be developed for libraries, blockchain use cases should be taken case by case and involve all stakeholders in each case to assist in informing the regulatory framework formulation for successful adoption (Smith, 2019).

CHAPTER 3 : RESEARCH DESIGN AND METHODOLOGY

3.1. Introduction

Research design and methodology establishes the structure of the research and discusses the research philosophies applied by the researcher, approach to theory, strategies, and methods. It is in this section whereby outline of the methods and processes which were followed in the study, are clearly stated. Therefore, it is a very important element that clarifies all the steps followed to achieve the research objectives (Al Kilani & Kobziev, 2016). Kothari (2004) defines it as the way of systemically answering the principal research question and sub-questions.

3.2. Philosophical consideration

Research philosophy refers to a set of beliefs and assumptions made on how data about a phenomenon has to be collected, analysed, and used to develop knowledge (Saunders, Lewis, & Thornhill, 2019). It is the conceptual lens that guides the researcher to determine the research methods to be used throughout the investigation of the phenomenon of interest. Therefore, it is crucial to state the worldview of the researcher from the beginning of the research project because it has influence on the decisions made in the research process. That is, research methods used, data analysis and interpretation (Kivunja & Kuyini, 2017).

3.2.1. Ontology

Ontology refers to the way researchers view the social world, and the social phenomena which make up that social world (Matthews & Ross, 2010). These assumptions shape the way in which researchers study their research objects (Saunders et al., 2019). There are two main ontological positions which are mostly considered in social science research, namely, objectivism and subjectivism.

Objectivism asserts that social phenomena that form the social world exist independent of the social actors which are involved. A researcher has no influence on the social phenomenon (Matthews & Ross, 2010).

Subjectivism asserts that social phenomena are the constructed ideas that are continuously being reviewed by the social actors through interaction and reflection. A researcher attaches their own understanding and meaning to the study (Matthews & Ross, 2010).

Ontological position adopted for this study was objectivism as the researcher was of the view that knowledge exists externally to the subjects and was interested in investigating the phenomenon in a value-free manner, without influencing its outcome.

3.2.2. Epistemology

Epistemology refers to the way researchers get to know reality or things that make up the social world (Blaikie, 2010). Main epistemological positions considered are positivism and interpretivism.

Positivism, being one of the epistemological positions used in information systems, relates to the philosophical stance of the natural scientist, and entails experimentation process to explore observations with measurable properties independent of the researcher, to produce law-like generalisation (Saunders et al., 2019; Kivunja & Kuyini, 2017). Any knowledge of reality that is not derived from experience is rejected by positivism (Blaikie, 2010). Positivist approach focuses on producing pure data that is free from human influence through interpretation or bias, to objectively predict behaviour (Saunders et al., 2019). The collected data is used to test hypotheses which are generated from the existing theory (Matthews & Ross, 2010).

Interpretivism states that knowledge comes from people's subjective understandings and interpretations of the social phenomena, this links back to the ontological position of subjectivism. The way social actors interpret the social phenomena of interest, is studied in order to explore different perspectives, with the acknowledgement that researchers cannot avoid influencing the phenomena of the study (Matthews & Ross, 2010; Saunders et al., 2019). Interpretivists contend that there are multiple interpretations of reality which form part of the scientific knowledge being pursued (Saunders et al., 2019).

This study adopted the positivist epistemology, which is underpinned by the objectivist ontological position, which is of the view that knowledge exists externally to the social actors and is mostly applied for identification of causal relationships to human behaviour obtained from data without researcher's influence (Creswell, 2014) with some degree of probability (Lin, 1998). Creswell (2014) further explains positivism as the philosophy that determines factors that influence a particular result. Therefore, positivist approach with objectivist ontology, was found to be suitable to objectively measure and predict the intention to adopt blockchain technology in academic libraries through quantitative means of data collection and analysis. The approach helps the researcher to undertake the research in a value-free way as dictated by positivism, and the result of the research can be generalised to the academic libraries in the context of South Africa because of the survey design.

3.3. Approach to theory

Approach to theory is the logic of enquiry which provides a set of steps to be followed in order to answer 'what', 'how' and 'why' questions. These strategies differ in their ontological and epistemological assumptions and use of concepts and theories. Some strategies are associated with a particular philosophical and theoretical foundation whereas others can be connected to a number of them (Blaikie, 2010).

Choosing an approach to theory development enables the researcher to make informed decision about the research design, which is the overall plan of research involving questions about what kind of data and where data was collected, how data was interpreted to answer the initial research question (Saunders et al., 2019). Moreover, choosing an approach helps the researcher with the choice of strategies and methodologies that work for a particular research, enabling the design to cater for research constraints as well, for example, insufficient understanding of the subject (Saunders et al., 2019).

The deductive reasoning is the strategy that was used to explain the relationship between the concepts by proposing the existing theory to test its validity. Deductive approach stresses the need to explain the association between variables and it was considered to be suitable for pursuing the explanatory purpose study and answering the research questions (Al-Hashedi et al., 2011; Blaikie, 2010). The predictions (hypotheses) which were made by the researcher about the relationship between the variables were tested against the adapted theory. These hypotheses have been derived from the proposed research framework for blockchain technology adoption intention by academic libraries in South Africa. The study was dependent on different theories to derive a set of independent and dependent variables which were used to develop a conceptual framework, hence deductive approach has been followed to answer the research question, address the study purpose and validate the proposed research framework. The approach is also supported by the positivist epistemology adopted in the study because of its emphasis on structure, quantification, law-like generalisation and hypotheses testing. Although, deductive research may be quicker to complete, there is a risk of non-return of questionnaires (Saunders et al., 2019) which was experienced in this study during covid-19 lockdown period.

3.4. Research Strategy

To enhance on the generalisability and replicability of the findings from the sample to the population, the online survey was used in the form of self-administered structured questionnaire (Creswell, 2014; Kuan & Chau, 2001) to collect data from academic libraries in South Africa which are members of the regional consortia to be tested in the proposed research model. Structured questionnaire is the one with a set of answers from which the respondents can choose the most appropriate one under each question (Bhattacherjee, 2012). So, the questions were designed in such a way that respondents can understand and meaningfully respond to them since the questionnaire was self-administered, and the respondents could complete and return at their own convenient time (Bhattacherjee, 2012; Bryman, 2012). Given the time frame of this study, online survey which was administered on SurveyMonkey, has been found to be the cheaper and faster strategy to collect data from the geographically dispersed academic libraries in the country.

Since survey studies are associated with non-response bias, it must be properly addressed (Kuan & Chau, 2001). To alleviate the chance of non-response bias, the covering letter (Appendix B: Request for participation) explaining the purpose of research, why the respondents have been chosen, and providing guarantee of the confidentiality was sent along with the link to the questionnaire (Appendix A: Survey Questionnaire**)**. Moreover, non-respondents were sent reminder emails to improve on the response. Then, one month after the first reminder, the letter, together with the link were resent to non-respondents to effect further response.

3.5. Survey instrument design

The survey instrument was divided into two sections. Table 1 shows **Section A** of the questionnaire with nine (9) questions which consisted of *ordinal* and *nominal* data variables that captured demographic information of the respondents. *Nominal (categorical)* variable refers to a variable with categories which cannot be ranked, and *Ordinal* data variable is the one which can be ranked or ordered (like in *interval* variable), but with different distances across the range (Bryman, 2012).

Table 1. Section A of the questionnaire

Demographic information	Number of items	Source
Age group, Gender, Academic background, Speciality, Position occupied, Work Experience, Employment status, Number of library staff members, Name of the university library	9 (Q1-Q9)	(Israel & Tiwari, 2011; Koloniari et al., 2019)

Table 2 shows **Section B** with 37 questions with *ordinal* data variables which captured respondents' perceptions on intention to adopt blockchain technology with all items measured using 7-point Likert scale, from 1-strongly disagree to 7-strongly agree. Though number of items on the Likert scale does not significantly affect reliability and validity of the collected data, 7-point Likert scale was chosen to cater for respondents who are undecided on any of the questions. All the constructs and measurement items were adapted from the previous studies (Israel & Tiwari, 2011; Kuan & Chau, 2001; Liu et al., 2015; Maduku et al., 2016; Queiroz & Wamba, 2019; Salleh & Janczewski, 2016; Yang et al., 2015) and operationalised in the context of this study to ensure content validity and reliability. The full survey questionnaire is attached in Appendix A: Survey Questionnaire.

Table 2. Section B of the questionnaire

Construct	Code	Question items	Source
Relative Advantage (RA)	RA1	Q10. Using blockchain technologies will enable the libraries to share	(Israel & Tiwari, 2011;

	RA2 RA3 RA4	metadata records easily. Q11. Using blockchain technologies will help libraries use one credentialing system to improve libraries' productivity. Q12. Using blockchain will improve customer services. Q13. Using blockchain will improve the relationships between the libraries.	Kuan & Chau, 2001; Maduku, Mpinganjira & Duh, 2016; Queiroz & Wamba, 2019)
Complexity (CX)	CX1 CX2 CX3	Q14. Blockchain will require a lot of mental effort to use. Q15. Blockchain use will be too complex for our library activities. Q16. Skills needed to use blockchain technologies will be too complex for employees of the library.	(Maduku, Mpinganjira & Duh, 2016)
Compatibility (CT)	CT1 CT2 CT3 CT4	Q17. Blockchain technologies will be compatible with the existing library systems used. Q18. Blockchain technology will be compatible with library business processes. Q19. Blockchain technology will be compatible with the current IT architecture. Q20. On blockchain technology, libraries can connect to share any kind of information to form Inter-Planetary File System (IPFS).	(Yang, Sun, Zhang, & Wang, 2015)
Perceived Cost (PC)	PC1 PC2 PC3 PC4	Q21. The costs of adopting blockchain will be far greater than the expected benefits. Q22. The cost involved in maintaining blockchain system will be very high for our library. Q23. The cost involved in providing support systems for blockchain will be too high.	(Kuan & Chau, 2001; Lin, 2014: Maduku, Mpinganjira & Duh, 2016)

		Q24. The amount of money invested in training employees to use blockchain will be very high.	
Management Support (MS)	MS1 MS2 MS3	Q25. Top management will provide necessary support for blockchain technology adoption. Q26. Top management will provide resources necessary for blockchain technology adoption. Q27. Top management will support the use of blockchain technology.	(Lin, 2014; Maduku, Mpinganjira & Duh, 2016)
IT Readiness (IR)	IR1 IR2 IR3 IR4	Q28. Our library has the necessary resources to implement blockchain technologies. Q29. Our library has employees who can learn the use of blockchain technologies easily. Q30. There are employees who can provide new ideas on blockchain use for our library. Q31. There is a specific person (or a group of employees) available to assist in case of blockchain-related difficulties.	(Lin, 2014; Maduku, Mpinganjira & Duh, 2016; Queiroz & Wamba, 2019)
Industry Support (IS)	IS1 IS2 IS3	Q32. There will be adequate technical support for blockchain provided by blockchain services providers. Q33. Blockchain technology service providers are encouraging our libraries to adopt blockchain by providing us with free training sessions. Q34. Training for blockchain technology will be adequately provided by service providers and library consortia.	(Maduku, Mpinganjira & Duh, 2016)
Customer Pressure (CP)	CP1	Q35. Many of our customers will expect our library to adopt blockchain technology to eliminate duplication of efforts.	(Maduku, Mpinganjira & Duh, 2016)

	CP2 CP3	Q36. Our relationship with our customers will suffer if we do not adopt blockchain technology. Q37. Our customers will consider us to be forward thinking by adopting blockchain technology.	
Security and Privacy Regulatory Concern (SC)	SC1 SC2 SC3	Q38. Adherence to security standards and privacy relations will be a challenge with blockchain technology. Q39. It will be harder to assess compliance of all personal data recorded on blockchain with the requirements of data protection law. Q40. With the use of blockchain, there will be a concern of legal implication to non-compliance to security standards and privacy regulations.	(Salleh & Janczewski, 2016)
Trust (TR)	TR1 TR2 TR3	Q41. We think we can trust academic libraries consortia members. Q42. We trust academic libraries consortia members to keep our best interest in mind. Q43. We trust our partnerships with other academic libraries will fulfil our obligations.	**(**Liu, Ke, Wei, & Hua, 2015; Queiroz & Wamba, 2019)
Adoption Intention (IN)	IN1 IN2 IN3	Q44. Our library intends to adopt blockchain technologies in the near future. Q45. Our library intends to start using blockchain technology in the future. Q46. Our library will highly recommend blockchain technology for other libraries to adopt.	(Israel & Tiwari, 2011; Maduku, Mpinganjira & Duh, 2016; Queiroz & Wamba, 2019)

3.6. Population and study sampling

The population refers to the total number of cases which fall under some designated set of criteria (Saunders, Lewis, & Thornhill, 2009). Population elements are members of the population (Blaikie, 2010) and the target population of this study consists of all 24 academic libraries from universities in South Africa which are affiliated to five different regional academic library consortia (Weiner & Coetsee, 2013). The other two universities, from 26 South African public universities were excluded from the sample because they were not members of any of the regional academic library consortia. South Africa has been selected for this study because it is one of the largest producers of scientific research in Africa, with well-established academic libraries' partnerships through their regional consortia, yet there is no blockchain technology adoption study that has been done for academic libraries.

Sampling is the selection of members from the population with the relevant characteristics for the purpose of making inferences about the whole population (Bhattacherjee, 2012; Blaikie, 2010). Some sampling methods (techniques) fulfil the representation of the population from which the sample has been drawn while others do not (Blaikie, 2010). The sampling techniques used are categorised as probability and non-probability sampling techniques (Saunders et al., 2009). In probability sampling, every population element has a known chance of being selected while it is not the case in non-probability sampling technique. Probability sampling was used in this study as it is mostly associated with survey research where inferences can be made about the whole population to answer the research question (Blaikie, 2010; Saunders et al., 2009). The study objects were the library managers (senior and middle), library and information professionals, and Information Technology (IT) professionals working in the academic libraries in South Africa as the sample frame. The study sample was only made up of all 24 regional consortia member libraries that constituted the target population and were contacted for participation invitation to the study.

3.7. Pilot study

The pilot study was conducted with the sole purpose of identifying and rectifying ambiguity in the research instrument (Bryman, 2012). To make sure that all survey items were complete and relevant to the phenomenon investigated, the research instrument (questionnaire) was first reviewed by the researcher's supervisor before it could be sent to the participants. Bryman (2012) recommends that pilot study should be carried out on people who are not going to be the members of the sample to be used in the main study because they will affect the representativeness of the sample, especially for the probability sampling. The online version of the questionnaire was developed after review, and pre-test was conducted with the University of Cape Town (UCT) libraries' staff selected from the sample frame of academic libraries affiliated to academic libraries' consortia to ensure proper interpretation of the questions. The respondents were requested to give feedback on the clarity of the instructions and questions, layout of the questionnaire whether it was easy to read, and time taken to complete the questionnaire. Based on the test results, modifications were made accordingly. Following Bryman's (2012) view, UCT libraries' staff members were not included in the main research sample.

3.8. Data collection and analysis

Data analysis gives the meaning to the data collected and it happens at a later stage of research, though the researcher has to be fully aware of the techniques which are going to be used to analyse data at a 'fairly early stage' (Bryman, 2012). The study was cross-sectional since data was collected at one point in time. Since the study is explanatory, data was collected and analysed using quantitative methods. Quantitative approach is explained as the extreme of empiricism and uses statistical principles to analyse quantitatively collected data (Al Kilani & Kobziev, 2016). Online survey questionnaire, administered on SurveyMonkey, was the instrument that was used in the form of self- administered questionnaire for data collection and was developed from items adapted from the previous similar studies in the context of the proposed hypotheses of the current study. Technological, organisational, environmental contexts and inter-organisational relationships were covered by the questionnaire items including the demographic information about the participants and their institutions (Al-Hashedi et al., 2011).

As it was mentioned earlier, all 23 public university libraries in South Africa which are already in cooperation through their academic libraries' consortia were invited for participation in the study except UCT libraries which were used for pilot study. The survey was distributed to the institutions that responded to the invitation through emails of the designated contacts in order to forward to the potential participants because the researcher did not have participants' direct contacts. This email included request letter for participation explaining the purpose of the study (Appendix B: Request for participation**)**, ethics approval letter from the Faculty of Commerce, University of Cape Town (Appendix C: Ethics Approval) and the link to the survey questionnaire (Appendix A: Survey Questionnaire) to capture responses electronically. However, the response rate was not as expected, and data collection period tracked for six months (January to June) to reach at least over 100 responses. Possible explanation for this low response rate was COVID-19 pandemic which put the whole world into panic mode during data collection, and lack of awareness of blockchain technology.

The online data capture enabled easy export of data to excel and upload onto the Software Package for Social Sciences (SPSS) which was used for further analysis because of its comprehensibility and the availability of the licensed version to UCT students. With the help of the demographic data, sample characteristics were explained.

3.8.1. Data validity and reliability

Reliability refers to "the measure of consistency of scale for the constructs it is measuring", and the Cronbach's alpha coefficient was used indicate reliability (Israel & Tiwari, 2011, p. 146). When the coefficient is above 0.50, it shows that the scale is internally consistent for the constructs, and it is the most used indicator of reliability in Social Sciences (Israel & Tiwari, 2011).

Validity refers to the measure of accuracy of items (questions) whether they measure what they are intended to measure (convergent validity). That is, whether items under one construct relate to one another with low correlations with other items from different constructs (Discriminant or divergent validity). In addition to the pre-testing that was conducted, factor analysis was employed to statistically check for validity of the items whether they measure the intended constructs (Koloniari et al., 2019). Principal component analysis as the extraction method was used, with Promax with Kaiser normalisation rotation, setting the minimum Eigenvalue of 1.00 to run factor analysis. Promax oblique solution was preferred because it allows factors to be correlated with one another, while orthogonal rotation, such as Varimax, imposes a restriction that factors should not be correlated (Finch, 2006). The results are shown in Appendix D: Factor analysis.

3.8.2. Regression and correlation analysis

Regression analysis is the statistical technique that is used to determine the cause-effect relationship between variables and predict about a topic. The regression that uses one independent variable is referred to as univariate, whereas the one with more than one variable is called multivariate/multiple regression analysis. The assumptions of the multiple regression analysis are normality, linearity, and no multicollinearity that should be observed in the data to be analysed (Pederson, 2017).

Correlation analysis is used to determine the strength of relationship between variables without the cause-effect relationship that is predicted by using regression model. There are many ways of examining correlation, however Karl Pearson's correlation test was used in this study since it is the most widely used method in Social Sciences for normally distributed data (Kafle, 2019).

Multiple Linear Regression and Pearson's correlation analyses were used for the hypotheses testing since latent variables and organisational size variable used in the model were observed to be normally distributed in terms of skewness and kurtosis, no strong correlations, no illegitimate outliers, and no multicollinearity were found between the independent variables.

Unstandardised or raw coefficients (b) and p-values between the predictor variables and dependent variable were used to test the research hypotheses. The research hypothesis is supported, and null hypothesis gets rejected if p-value is less than or equal to 0.05 ($p<0.05$), otherwise, null hypothesis cannot be rejected. Regression coefficient (b) determines the direction of the relationship between variables, whether it is positive or negative, and the weight of influence a predictor variable has on the dependent variable (Pederson, 2017).

3.9. Ethics and confidentiality

Ethical clearance was obtained from the Commerce Faculty Ethics Committee in Research for conducting this study. The rights of the potential participants and their institutions were considered in the study. To ensure confidentiality of the data collected and privacy of the participants, the following were done:

- A cover letter requesting for participation, and explaining the concepts and purpose of the study was sent to the participants.
- No identifying information was requested from the respondents.
- The participants' responses were kept anonymous and confidential throughout and after the study.
- All participants were asked to voluntarily take part in the study, without any pressure and they could withdraw from the research participation at any time.

Since the study was objective, the researcher did not impose any bias during data collection process because the survey was self-administered, and there was no direct contact with the respondents. Even though the libraries' names were requested in the survey instrument to assess representation, they were not included in the final research report to avoid possible induction to identify participants. In case participants had any concerns and/or questions, contact details for the researcher and research supervisor were provided in the invitation letter.

The survey data was stored in the institutional cloud storage (one drive) where only the researcher and the supervisor had access and was synchronised with the researcher's password protected laptop storage. After the dissertation approval, data would be archived and kept in the institutional data repository.

3.10. Chapter summary

The purpose of this study was to determine the intention of the academic libraries in South Africa to adopt blockchain technology for their collaborative business processes. In this chapter, research design and methodology followed for this cross-sectional study were described. Objective ontological view of reality was adopted for the study, taking a positivist epistemology to gather knowledge. A deductive research approach was followed, using the TASC model as a lens to guide the research process with application of quantitative methods to collect and analyse data. Target population was made of academic library workers in South Africa, and all 24 university libraries which are members of academic libraries consortia were contacted for participation request. Self-administered online survey research strategy was used to collect data from geographically dispersed locations. The research instrument captured demographic information of the respondents, and their perceptions on the factors that influence the intention to adopt blockchain technology, as dependent variable. A total of 108 responses were collected from the academic libraries in South Africa, with 95 usable responses which were used for this study.

CHAPTER 4 : DATA ANALYSIS, FINDINGS AND DISCUSSION

4.1. Introduction

Chapter 4 presents data analysis results, findings of the study and discusses the findings to answer the research question. Quantitative data analysis techniques were applied to the data using Statistical Package for Social Sciences (SPSS) version 26. Data screening was performed on the data to prepare for appropriate statistical tests to be applied for the analysis. Construct reliability and composite reliability were evaluated using the value of Cronbach's alpha, and discriminant and convergent validities were also checked using factor analysis to evaluate whether the items load strongly on the intended constructs and weakly on the irrelevant constructs. After preliminary tests, multiple regression was used to identify the strength of the relationship between the main constructs of the proposed model, whereas correlation analysis was used to identify associations between the constructs. The outputs of the analyses, using descriptive and inferential statistics, were used to test the eleven hypothesised statements which ultimately led to the findings of the study. In data analysis, the following measures were used:

Table 3. Data analysis measures

Measure	**Correlation coefficient (r)**	**Statistical significance(p-value)**	**Coefficient of determination (R^2)**
Description	Gives the strength of the relationship between two variables in a linear regression	Determines the extent to which a result is influenced by chance or variable of interest in a sample, representative of the population	Determines the variance of dependent variable that is predictable from the independent variable
Value	$r>0.80$: Very strong $0.8>r>0.5$: Strong $r<0.5$: Weak	$p<0.01$: Highly significant $0.01<p<0.05$: Significant $p>0.05$: Not significant	Range: 0 to 1 0: dependent variable cannot be predicted from the independent variable. 1: dependent variable can be predicted without an error from the independent variable.

4.2. Data screening

Data screening is a crucial stage in research as it serves as a founding block in giving meaningful outcome to the quantitative study (Abdulwahab, Dahalin & Galadima, 2011). From the 108 responses captured, 12 cases were removed from the dataset due to over 20% of missing data.

Another case which was discarded, showed an unengaged response where the respondent answered **Neither agree nor disagree** to all Likert scale questions. It was further observed that the following variables had missing values (shown in brackets), but not exceeding 20%: Age (3), Gender (2), Education (5), Speciality (3), Position (2), Work_exp (1), Emp_status (1), Org_size (1), CT1 (1), IR2 (1), IR4 (1), IS3 (1), SC3 (1), TR2 (1), IN2 (1).

Missing values for gender were replaced by **Prefer not to answer (3)** as it was assumed that respondent did not want to disclose their gender under this variable. Under variables Education level, Speciality, and Position, **Other** was given for the missing values as it was deemed that values for these variables were not among the given options hence why missing values. For Age, Work experience, Employment status and Organisational size variables, mode values were used for the missing values. For Employment status, '**Other**' could have been used for missing value, but none of the respondents had chosen this option which reduced the chances of being the option for the missing values. For the Likert scale indicator variables (CT1 to IN2), surrounding values of the indicators for the latent variable were looked at, and mode value for each case was used to impute the missing values. If no mode value was found, average of the surrounding values of the indicators for a latent variable was used. A total of 95 usable responses were retained for further analysis.

4.3. Respondent profile

Demographic information was requested from the respondents to understand the profile of the academic library workers in South Africa. This data was useful in providing the insight of what kind of workers participated in the study survey. The name of the main library worked for, was requested from the participants in order to establish whether regional consortia were represented or not. It was found that from 23 invitations sent, only 10 academic libraries responded, from four regional consortia, namely, Cape Library Consortia (CALICO), South Eastern Alliance of Library Systems (SEALS), Eastern Seaboard Association of Libraries (ESAL), and Gauteng and Environs Library Consortium (GAELIC), with Free State Library and Information Consortium (FRELICO) not represented. This gives 43.5% response rate, which was based on the institutions instead of the study respondents. This was done because the researcher did not have direct access to the participants, and did not solicit the number of potential participants from their institutions' contact person. Furthermore, the response rate that is approximately 35% for academic studies involving organisation's representative is acceptable (Baruch, 1999). The names of the libraries were not used in any further analysis to keep the anonymity and confidentiality of the respondents.

The data collected showed the representation of 38.9% for male, and 55.8% for female respondents, while 5.3% preferred not to answer. As indicated in

Table 4, none of the respondents were below 25 years of age, and the age group of '45 and above' got the highest score of 43.2%, followed by '35-44' with 36.8%, and '25-34' with 20%. Most of the respondents surveyed were master's degree holders with 52.6%, followed by 23.2% of bachelor's degree holders, 14.7% of other qualifications and 9.5% of PhD holders.

Library and Information Studies (LIS) profession respondents were dominant with 85.3%, Information Technology (IT) profession was represented by only 10.5% and 4.2% represented other professions working in academic libraries. Of the 95 responses used, 4.2% were from the library directors, 34.7% were from the heads of divisions/sections, whereas 61.1% were from other academic library workers.

In terms of working experiences, none of the respondents had less than one year of working experience in the academic library. 7.4% had 1-5 years, 22.1% had 6-10 years, 18.9% had 11-15 years, 33.7% had 16-20 years, and 17.9% had above 20 years. 98.9% of the respondents were permanently employed, with 1.1% on renewable contract and no one was on fixed term contract. Most (61.1%) of the responded libraries have 55 and more staff members, 10.5% with 45-54, 9.5% with 35-44, 7.4% with 25-34, 5.3% with 15-24 and 6.3% with employees below 15.

Table 4. Respondent profile

Demographic variable	Category	Frequency	Percentage
Age (years)	Under 25	0	0.0
	25-34	19	20.0
	35-44	35	36.8
	45 and above	41	43.2
Gender	Male	37	38.9
	Female	53	55.8
	Prefer not to answer	5	5.3
Academic background	Bachelor's degree	22	23.2
	Master's degree	50	52.6
	PhD	9	9.5
	Other	14	14.7
Speciality	LIS professional	81	85.3
	IT professional	10	10.5
	Other	4	4.2
Position	Library director	4	4.2
	Head of division/section	33	34.7
	Other	58	61.1
Work Experience (years)	Under 1	0	0.0
	1-5	7	7.4
	6-10	21	22.1
	11-15	18	18.9
	16-20	32	33.7
	21 and above	17	17.9
Employment status	Permanent contract	94	98.9
	Renewable contract	1	1.1
	Fixed term contract	0	0.0
	Other	0	0.0
Number of library staff members	Below 15	6	6.3
	15-24	5	5.3
	25-34	7	7.4
	35-44	9	9.5
	45-54	10	10.5
	55 and above	58	61.1

4.4. Reliability test

Reliability test was conducted for each of eleven constructs using Cronbach's alpha to determine consistency of the scale in measuring the constructs (internal reliability) and pick the items which can be removed from each construct to improve its reliability. The coefficient that is above 0.60 shows that the scale is internally consistent for the construct (Lin, Chang, Chou, Chen, & Ruangkanjanases, 2021). The results are shown in Table 5 below.

Table 5. Reliability Results

Construct	Items	Number items	Reliability (Cronbach's alpha)
Relative Advantage (RA)	Q10-Q13	4	0.896
Complexity (CX)	Q14-Q16	3	0.895
Compatibility (CT)	Q17-Q20	4	0.821
Perceived Cost (PC)	Q21-Q24	4	0.919
Management Support (MS)	Q25-Q27	3	0.885
IT Readiness (IR)	Q28-Q31	4	0.753
Industry Support (IS)	Q32 and Q34	2(IS2 removed)	0.847
Customer Pressure (CP)	Q35-37	3	0.797
Security Concern (SC)	Q38-Q40	3	0.817
Trust (TR)	Q41-Q43	3	0.894
Blockchain Adoption Intention (IN)	Q44-Q46	3	0.872

As seen from Table 5, all constructs indicate Cronbach's alpha values above 0.6, which is considered to indicate a lower threshold for a reliable scale (Lin et al., 2021), after item IS2 (Q33) was dropped because of cross loading. Internal reliability was therefore considered to be acceptable. The implication is that correlation among the group of items measuring the constructs was good (Field, 2013).

4.5. Validity test

Following reliability test, factor analysis was conducted to understand the factors that form the questions of this research. This measures the accuracy of question items whether they measure what they were intended to measure. In addition, factor analysis identifies items that belong to the same factor or construct. From the results, it can be confirmed whether the question items were properly phrased and understood by the respondents. However, factorability of correlation matrix should be supported in order to run factor analysis. According to the results shown in Table 6 by Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy of 0.68, and Bartlett's Test of Sphericity of 2761.636 which is significant at $p<.001$, factorability of correlation matrix was supported. Kaiser (1974) posits that KMO value above 0.6 is acceptable for factor analysis to be conducted.

Table 6. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.680
Bartlett's Test of Sphericity	Approx. Chi-Square	2761.636
	Df	630
	Sig.	.000

The results of factor analysis are found in Appendix D: Factor , showing loadings of each question item onto each construct or factor. A total of eleven factors were extracted as predicted, with 80.8% of variance explained in the sample data. The question items with loadings of 0.4 and below were suppressed. Principal component analysis as the extraction method, and Promax with Kaiser normalisation rotation with minimum Eigenvalue of 1.00 were used to run factor analysis, and the question items had factor loadings which were above 0.5.

All items loaded on their intended individual factors, except question item Q33 (IS2) for Industry Support (IS) that had loading of 0.593 on the intended factor (Industry Support) with cross loading of 0.547 on Perceived Cost (PC). As a result, question item IS2 was dropped from the data set to improve on the convergent validity of the construct for further analysis, which also improved composite reliability from 0.628 to 0.847 in the reliability analysis.

4.6. Descriptive statistics

The question items in section B of the questionnaire (Q10-46) were formulated based on the constructs of the proposed model. To compute the score for the constructs, mean of the question items used under each construct was obtained. The summary of data for the constructs is as shown in Table 7 below.

Table 7. Descriptive statistics

Variable	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Relative Advantage	1.00	7.00	5.8211	1.15757	-1.449	.247	3.070	.490
Complexity	1.00	6.00	3.6947	1.41477	.054	.247	-.958	.490
Compatibility	2.00	7.00	5.1684	.95263	-.271	.247	.591	.490
Perceived Cost	2.00	6.00	3.7684	1.12470	.105	.247	-.701	.490
Organisational Size	1.00	6.00	4.9579	1.58393	-1.357	.247	.566	.490
Management Support	2.00	7.00	4.5053	1.01974	-.045	.247	.163	.490
IT Readiness	1.00	7.00	4.9158	1.00703	-.722	.247	1.633	.490
Customer Pressure	1.00	7.00	4.4947	1.13806	-.053	.247	.057	.490
Industry Support	2.00	7.00	4.4737	1.04007	.158	.247	.024	.490
Security Concern	1.00	7.00	4.5895	1.09636	-.307	.247	.472	.490
Trust	1.00	7.00	5.5053	.98795	-1.164	.247	3.593	.490
Intention	2.00	7.00	4.2526	1.10095	.115	.247	.064	.490

The mean score for the constructs used in the model ranged from 3.69 to 5.82 with standard deviations between 0.95 and 1.58, indicating good data distribution because of small differences between means and medians. Additionally, in terms of skewness, values ranged from -1.45 to 0.12. However, mild kurtosis was observed for the latent variables; relative advantage and trust, with values of 3.07 and 3.59, respectively. Strict normality rules have not been violated since values appear within the more relaxed rules suggested by West, Finch and Curran (1995) who recommend 3 for skewness and 7 for kurtosis as the upper thresholds for normality. Following their recommendation, distribution of data for the latent variables for this study was considered normal for further analysis. As a result, there was no data transformation required.

4.7. Correlation analysis

Pearson's correlation analysis was performed to examine the strength of the relationship between the model constructs, and the results are shown in Table 8. No significant correlations were observed between the dependent variable, Intention to adopt blockchain (IN) and the following independent variables, Relative Advantage, Complexity, Perceived Cost, IT Readiness, Industry Support, Security Concern, Inter-organisational Trust, and Organisational Size. Compatibility had weak and significant ($p<0.05$) correlation at .258, whereas Management Support and Customer Pressure had weak, but highly significant ($p<0.01$) correlations at .265 and .375 respectively, with Intention to adopt blockchain. According to the results in Table 8, some independent variables had weak, but significant and highly significant correlations with one another. However, results presented in Table 11. Regression analysis indicate that there is no multicollinearity among the independent variables, and that allowed the researcher to proceed with regression analysis using the same variables.

Table 8. Pearson correlation analysis

		RA	CX	CT	PC	OS	MS	IR	CP	IS	SC	TR	IN
Relative Advantage (RA)	r	1											
	p												
Complexity (CX)	r	-.237*	1										
	p	.021											
Compatibility (CT)	r	.357**	-.316**	1									
	p	.000	.002										
Perceived Cost (PC)	r	-.298**	.561**	-.436**	1								
	p	.003	.000	.000									
Organisational Size (OS)	r	.165	-.022	-.071	.033	1							
	p	.110	.830	.493	.753								
Management Support (MS)	r	.184	-.395**	.303**	-.296**	.128	1						
	p	.074	.000	.003	.004	.215							
IT Readiness (IR)	r	.225*	-.308**	.137	-.121	-.075	.446**	1					
	p	.029	.002	.186	.241	.472	.000						
Customer Pressure (CP)	r	.304**	-.306**	.303**	-.327**	-.097	.329**	.218*	1				
	p	.003	.003	.003	.001	.352	.001	.034					
Industry Support (IS)	r	.139	-.156	.169	.063	.367**	.337**	.172	.100	1			
	p	.179	.130	.101	.545	.000	.001	.096	.336				
Security Concern (SC)	r	.054	.133	-.010	.138	.148	-.124	-.138	.046	.142	1		
	p	.603	.198	.926	.183	.154	.230	.183	.660	.171			
Inter-Organisational Trust (TR)	r	.275**	-.144	.232*	-.092	.141	.083	.128	.106	.233*	.162	1	
	p	.007	.164	.023	.374	.174	.421	.218	.308	.023	.118		
Intention to adopt blockchain (IN)	r	.161	-.198	.258*	-.134	-.046	.265**	.023	.375**	.179	-.117	.150	1
	p	.119	.054	.011	.195	.657	.009	.827	.000	.083	.258	.148	

NOTE: ***. Correlation is significant at the 0.05 level, **. Correlation is highly significant at the 0.01 level**

4.8. Multiple regression analysis

Fairly normal distributions were observed among the latent variables, and demographic variables, with the exception of employment status, with values above the suggested absolute values of 3 for skewness and 7 for kurtosis by West et al. (1995) as the upper thresholds for normality.

Multiple linear regression was therefore used in the study to determine whether or not the eleven variables in the regression model have significant influence on the intention to adopt blockchain technology in South African academic libraries. The variables used were relative advantage, complexity, compatibility, technology cost, organisational size, management support, IT readiness, industry support, customer pressure, security concern and inter-organisational trust. The results of the analysis are shown in Table 9, Table 10, and Table 11

Table 9 shows the model summary which is useful in evaluating the overall effect of the set of predictor variables on the dependent variable. R-square value of .244 is indicative of approximately 24% of variance in data for Intention to adopt blockchain that was accounted for by the predictor variables shown in the model summary below. The remaining 76% might be caused by other predictor variables which were not captured in the research model.

Table 9. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.494[a]	.244	.143	.94281	.244	2.431	11	83	.011

a. **Predictors:** (Constant), Trust (TR), Perceived Cost (PC), Organisational Size (OS), IT Readiness (IR), Security Concern (SC), Customer Pressure (CP), Relative Advantage (RA), Compatibility (CT), Industry Support (IS), Complexity (CX), Management Support (MS)

b. **Dependent Variable:** Intention to adopt blockchain (IN)

The analysis of variance in Table 10 is useful in testing the statistical significance of the R-square value in the model summary table, and the results in Table 10 show statistical significance, which suggest that the R-square of the population is significantly greater than zero [$F(11,83)=2.431$, $p<.05$].

Table 10. Analysis of variance (ANOVA)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	23.770	11	2.161	2.431	.011[b]
	Residual	73.778	83	.889		
	Total	97.549	94			

a. **Dependent Variable:** Intention to adopt blockchain

b. **Predictors:** (Constant), Trust (TR), Perceived Cost (PC), Organisational Size (OS), IT Readiness (IR), Security Concern (SC), Customer Pressure (CP), Relative Advantage (RA), Compatibility (CT), Industry Support (IS), Complexity (CX), Management Support (MS)

Absence of multicollinearity among the independent variables in a regression model is one of the key assumptions of multiple regression analysis, and in this output, it is measured using two indices: tolerance and variance inflation factor (VIF). Tolerance values below .10 may indicate presence of multicollinearity. In addition to that, VIF is indicative of multicollinearity if its value is above 10 (Fosso Wamba & Guthrie, 2020). According to the results shown in Table 11, all VIF values are below 2, which is far less than 10 and tolerance values are above .10. This proves the absence of multicollinearity among the independent variables in the regression model.

Table 11. Regression analysis

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	T	Sig. (p-value)	Tolerance	VIF
1	(Constant)	2.089	1.317		1.586	.117		
	Relative Advantage (RA)	.031	.111	.032	.280	.780	.705	1.419
	Complexity (CX)	-.069	.098	-.086	-.697	.488	.595	1.682
	Compatibility (CT)	.142	.143	.115	.992	.324	.677	1.477
	Perceived Cost (PC)	.144	.121	.150	1.193	.236	.573	1.744
	Organisational Size (OS)	-.043	.069	-.067	-.630	.530	.795	1.257
	Management Support (MS)	.192	.131	.183	1.468	.146	.588	1.701
	IT Readiness (IR)	-.230	.125	-.209	-1.847	.068	.709	1.411
	Customer Pressure (CP)	.303	.104	.322	2.918	.005	.746	1.340
	Industry Support (IS)	.062	.126	.059	.490	.626	.635	1.575
	Security Concern (SC)	-.175	.107	-.170	-1.635	.106	.840	1.191
	Trust (TR)	.116	.117	.107	.994	.323	.786	1.272

a. **Dependent variable:** Intention to adopt blockchain.

According to the regression analysis results, ten (10) predictor variables emerged as non-significant (p>0.05) predictors of intention to adopt blockchain technology, except customer pressure. Customer pressure appears to be the only highly significant positive predictor (B=.328) of intention to adopt blockchain with p-value of 0.005 (p<0.01). The positive predictor variables are relative advantage (B=.031), perceived cost (B=.144), inter-organisational trust (B=.116), management support (B=.192), industry support (B=.062), and compatibility (B=.142), and negative predictors are organisational size (B=-.043), IT readiness (B=-.230), and complexity (B=-.069), with non-significant influence over intention to adopt blockchain.

4.9. Findings and discussions

In this section, the research hypotheses which have been formulated from the TASC model presented in Chapter 1, were being assessed using regression analysis, correlation analysis, and descriptive analysis. Moreover, model constructs or latent variables were represented using tables and graphs to give the mode and overall average responses of the participants. The mode tells the most common response to each statement while the mean gives the overall average response. The findings were further discussed in relation to the formulated research hypotheses, highlighting any corroborations and contradictions with the previous studies. These techniques led to answering the research questions formulated in Chapter 1. The study reveals the important factors to consider for blockchain adoption intention, perception of blockchain, and possible applications of blockchain in academic libraries, which can be used as the foundation in advancing adoption literature for collaborative operations.

Eleven groups of Likert question items were given the same response choices: 1= Strongly disagree, 2= Disagree, 3=Somewhat disagree, 4=Neither agree nor disagree, 5=Somewhat agree, 6=Agree, 7= Strongly agree. Each group measures its respective latent variables, some of which were slightly correlated to one another as reflected in Table 8**.** The composite scores of latent variables were considered interval scale because they were generated from the combination of items intended to measure a single construct (Joshi, Kale, Chandel, & Pal, 2015), and the range was calculated as shown in Table 12 below. The 7-point Likert scale ranges from 1 to 7, so the range was calculated by deducting maximum from the minimum value on the scale (7-1=6). The result was divided by the greatest value on the scale (6/7=0.86), to give the interval between the options or points on a scale.

Table 12. Scale range for latent variables

Scale	**Scale Range**	**Response**	**Interpretation**
7	6.17 – 7.02	Strongly agree	Strongly agree
6	5.31 – 6.16	Agree	Agree
5	4.45 – 5.30	Somewhat agree	Slightly agree
4	3.59 – 4.44	Neither agree nor disagree	Uncertain
3	2.73 – 3.58	Somewhat disagree	Slightly disagree
2	1.87 – 2.72	Disagree	Disagree
1	1 – 1.86	Strongly disagree	Strongly disagree

4.9.1. Intention to adopt blockchain technology (IN)

The majority of the respondents were uncertain with the statements **IN1, IN2** and **IN3** that measure the intention of their libraries to adopt blockchain with 45.3%, 45.3% and 41.1%, respectively. The results are shown in

Table 13 below. When respondents were asked whether their libraries intend to adopt blockchain in the near future (**IN1**), 17.9% slightly agreed, 15.8% slightly disagreed, 12.6% agreed, 7.4% disagreed, whereas only 1.1% strongly agreed. Regarding statement, **IN2**, 18.9% slightly agreed with **IN2**, 14.7% slightly disagreed, 11.6% agreed, 8.4% disagreed and 1.1% strongly agreed. 20.0% of the respondents slightly agreed with **IN3**, 17.9% agreed, 10.5% slightly disagreed, 6.3% agreed, and 4.2% strongly agreed.

Table 13. Descriptive results for intention to adopt blockchain items (N=95).

Response	**IN1** Our library intends to adopt blockchain technologies in the near future.	**IN2** Our library intends to start using blockchain technology in the future.	**IN3** Our library will highly recommend blockchain technology for other libraries to adopt.
1. Strongly disagree	0.0%	0.0%	0.0%
2. Disagree	7.4%	8.4%	6.3%
3. Somewhat disagree	15.8%	14.7%	10.5%
4. Neither agree nor disagree	45.3%	45.3%	41.1%
5. Somewhat agree	17.9%	18.9%	20.0%
6. Agree	12.6%	11.6%	17.9%
7. Strongly agree	1.1%	1.1%	4.2%

According to the intention bar chart in Figure 4 below, which shows the overall response to intention to adopt blockchain by the libraries, most of the responses fall in the range of **neither agree nor disagree**, which is defined in Table 12. These results are consistent with the most common responses to the three statements that measure this dependent variable, whose results are shown in

Table 13. The implication is that participants were clouded by the uncertainty as to whether their libraries will adopt or recommend blockchain to their counterparts in future, probably because there is still lack of or limited knowledge about blockchain technology among the academic library professionals. Wong, Tan et al. (2020) in their study, found lack of awareness and knowledge about blockchain technology in supply chain management to negatively affect usefulness and effort expectancy required to influence blockchain adoption. However, there could be other factors

that contribute to the uncertainty in intending to use blockchain technology other than lack of awareness and knowledge of the technology in academic libraries. Users in doubt of new technology, are likely not to adopt it regardless of the benefits inherent in that technology (Wong, Tan et al., 2020). Wheatley and Hervieux (2020) posit that historically, libraries have been reluctant to change, they would rather wait for a particular technology to reach market saturation, and their patrons be exposed to such technology through other avenues before they can adopt its use.

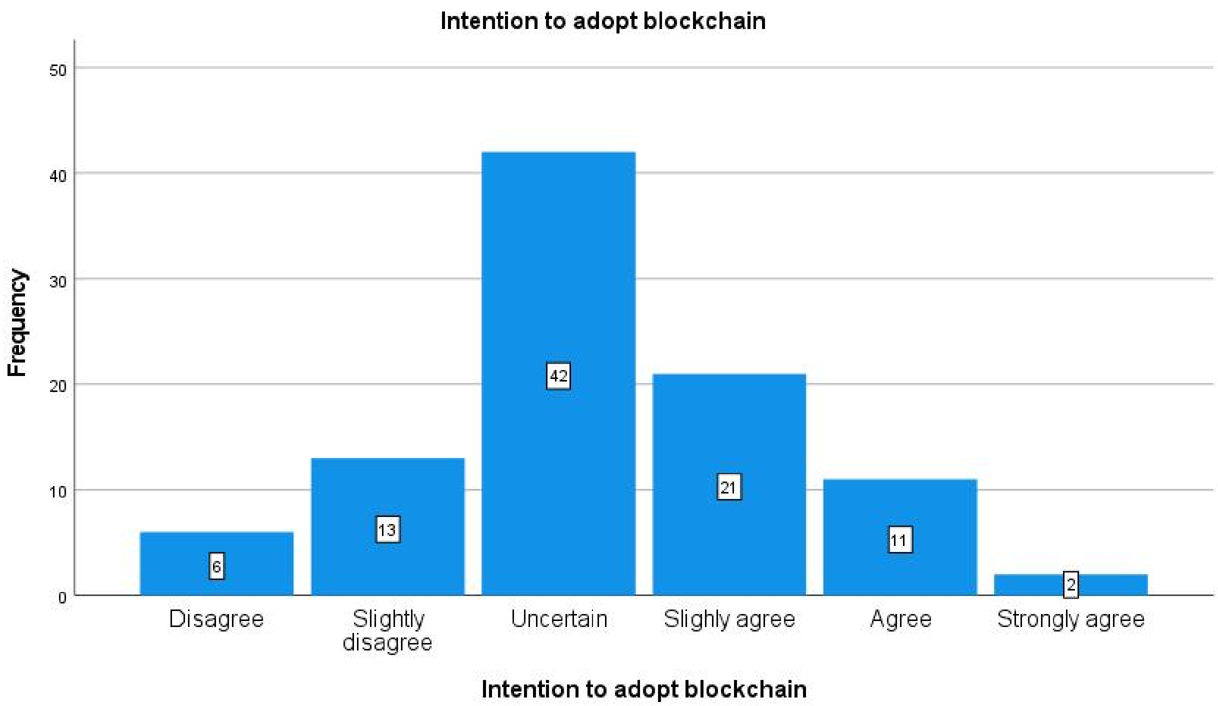

Figure 4. Descriptive results for intention to adopt blockchain.

4.9.2. Relative advantage (RA)

H1: *The perceived relative advantage of the technology positively affects the intention to adopt blockchain technology.*

According to the regression analysis results, there was a positive relationship between Relative Advantage (RA) and Intention to adopt blockchain (IN) which is not significant ($p>0.05$). Pearson correlation test results confirmed non-significant positive relationship between these two constructs.

The respondents were asked whether using blockchain will enable them to share distributed metadata easily. As indicated in Table 14, Only 2.1% disagreed, while 4.2% neither agreed nor disagreed. Over 83% (18.9%, 48.4% and 26.3%) were positive about reaping the benefits by using blockchain for distributed metadata records. Regarding the use of blockchain for one shared credentialling system to improve libraries' productivity, 4.2% (2.1% and 2.1%) disagreed, 8.4% were uncertain, while 87.3% (11.6%, 47.4% and 28.3%) agreed with the statement. Similarly, only 6.4% (3.2% and 3.2%) disagreed to using blockchain will improve customer service, while 11.6% neither agreed nor disagreed, 82.1% (13.7%, 46.3% and 22.1%) agreed with the statement. When asked whether using blockchain will improve relationship between libraries, only 3.3% (1.1%, 1.1% and 1.1%) disagreed, whereas 15.8% neither agreed nor disagreed, 81% (24.2%, 38.9% and 17.9%) agreed.

Table 14. Descriptive results for relative advantage items (N=95).

Response	**RA1** Using blockchain technologies will enable the libraries to share metadata records easily.	**RA2** Using blockchain technologies will help libraries use one credentialing system to improve libraries' productivity.	**RA3** Using blockchain will improve customer services.	**RA4** Using blockchain will improve relationships between the libraries.
1. Strongly disagree	2.1%	2.1%	3.2%	1.1%
2. Disagree	0.0%	0.0%	0.0%	1.1%
3. Somewhat disagree	0.0%	2.1%	3.2%	1.1%
4. Neither agree nor disagree	4.2%	8.4%	11.6%	15.8%
5. Somewhat agree	18.9%	11.6%	13.7%	24.2%
6. Agree	48.4%	47.4%	46.3%	38.9%
7. Strongly agree	26.3%	28.4%	22.1%	17.9%

Although regression and correlation analyses did not show any significant relationship between relative advantage and intention to adopt blockchain, the overall descriptive response of the most participants, 40 (42.1%) shown in Figure 5, depicts that blockchain technology will provide relative advantage when integrated in their business processes. The potential benefits can be realised from distributed ledger of shared metadata, accessible to everyone in a peer-to-peer network. This can also improve cost efficiency by eliminating third party and enhancing relationship with the stakeholders by delivering information services on time since duplication of effort would be eliminated by using a common credentialing system. However, the study finding contradicts with prior literature on innovation adoption, which has been found to be influenced by relative advantage (Lin, 2014; Maduku et al., 2016; Wong, Leong, et al., 2020). It is, therefore, necessary for blockchain service providers to develop blockchain systems with functionalities that will address the current academic libraries' challenges and communicate their innovation benefits to the key decision makers and potential users. Hypothesis, H1 was therefore rejected, and $H1_0$ was accepted.

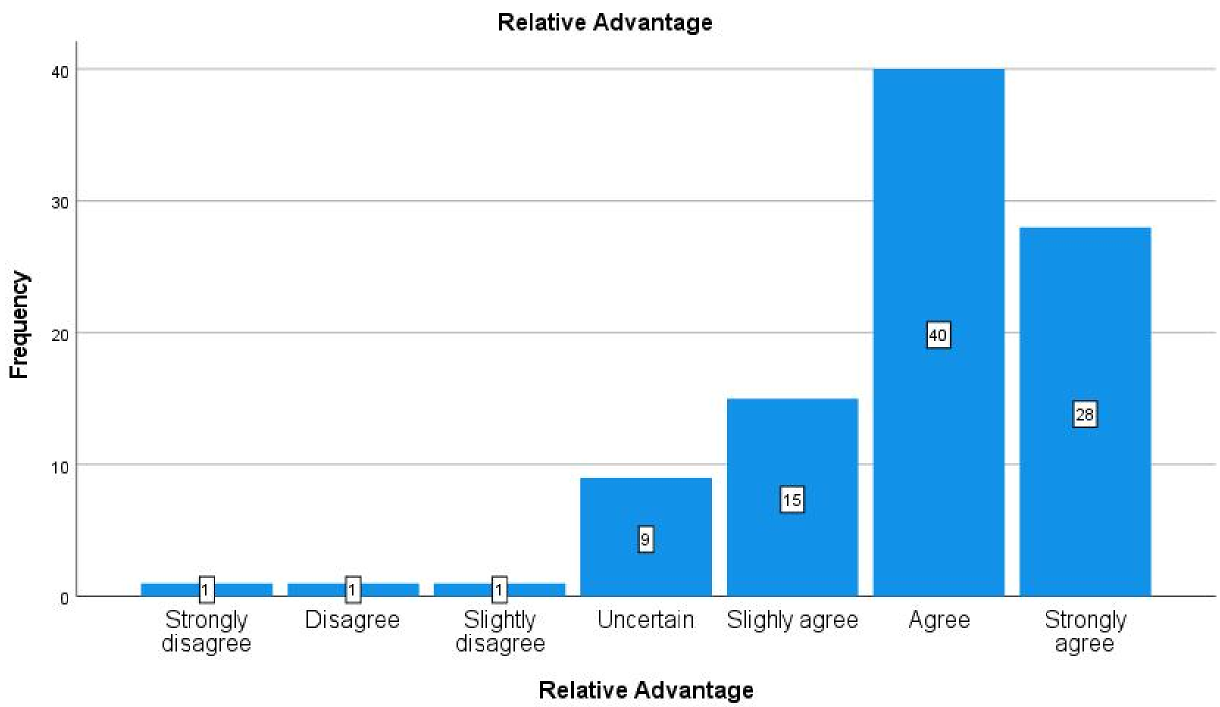

Figure 5. Descriptive results for relative advantage (RA)

4.9.3. Complexity (CX)

H2: *The complexity of the technology negatively affects the intention to adopt blockchain technology.*

Complexity (CX) of blockchain technology showed no significant influence on the Intention to adopt blockchain technology (IN) according to the regression analysis output. Pearson's correlation results are consistent with the regression analysis results in that, there is no significant relationship between Complexity and Intention to adopt blockchain. However, non-significant relationship shows a negative direction as hypothesised in **H2**.

With descriptive results shown in Table 15, when respondents were asked whether blockchain will require a lot of mental effort to use, 42.1% (22.1%,15.8%,4.2%) which forms the majority, disagreed with the statement, 22.1% did not know what to expect and 35.7% (18.9,14.7 and 2.1) agreed with **CX1**. When asked whether blockchain will be too complex for their library activities, 51.6% (3.2%, 20.0% and 28.4%) disagreed, 17.9% did not have idea, whereas 30.6% (23.2% and 7.4%) agreed. Regarding statement **CX3**, 51.5% (6.3%, 18.9% and 26.3%) disagreed, 14.7% were not sure whether to agree or disagree with the statement, and 33.7% (26.3% and 7.4%) agreed.

Table 15. Descriptive results for complexity items (N=95).

Response	**CX1** Blockchain will require a lot of mental effort to use.	**CX2** Blockchain use will be too complex for our library activities.	**CX3** Skills needed to use blockchain technologies will be too complex for employees of the library.
1. Strongly disagree	4.2%	3.2%	6.3%
2. Disagree	15.8%	20.0%	18.9%
3. Somewhat disagree	22.1%	28.4%	26.3%
4. Neither agree nor disagree	22.1%	17.9%	14.7%
5. Somewhat agree	18.9%	23.2%	26.3%
6. Agree	14.7%	7.4%	7.4%
7. Strongly agree	2.1%	0.0%	0.0%

Most item responses indicate moderate disagreement to perceived complexity of blockchain, followed by moderate agreement. The overall response of the most participants fell within the range of slightly disagree (23), which implies that blockchain technologies will not be complex to use if integrated into the academic libraries' activities. The results are graphically shown in Figure 6 below. According to Toufaily, Zalan, and Dhaou's (2019) and Wong, Leong et al. (2020) studies, one of the barriers to mass adoption of blockchain was found to be its perceived complexity. The study results show mixed perceptions towards blockchain complexity, which warrants further investigation in this direction. Maduku et al. (2016) assert that insignificance of complexity in adoption is attributed to self-efficacy in technology use, which renders complexity a non-determining factor. However, in this study, complexity did not show any relationship with the intention to adopt blockchain. Rather, the participants' responses indicate that academic libraries in South Africa have professionals with a lot of uncertainty about the complexity of blockchain technologies. Possible explanation may be attributed to non-existence of the actual use case in South African libraries to date that can be used as a reference because of the early stages of blockchain technology development. Therefore, blockchain as a nascent technology, is not well understood by academic library professionals. Despite the potential benefits of blockchain to be realised by academic libraries, a notable number of responses (20) indicate uncertainty in its complexity, which may pose a threat to the uptake. This calls for blockchain service providers to intensify their marketing of blockchain technology services that can benefit academic libraries by improving their operations. H2 was therefore rejected, and $H2_0$ was supported.

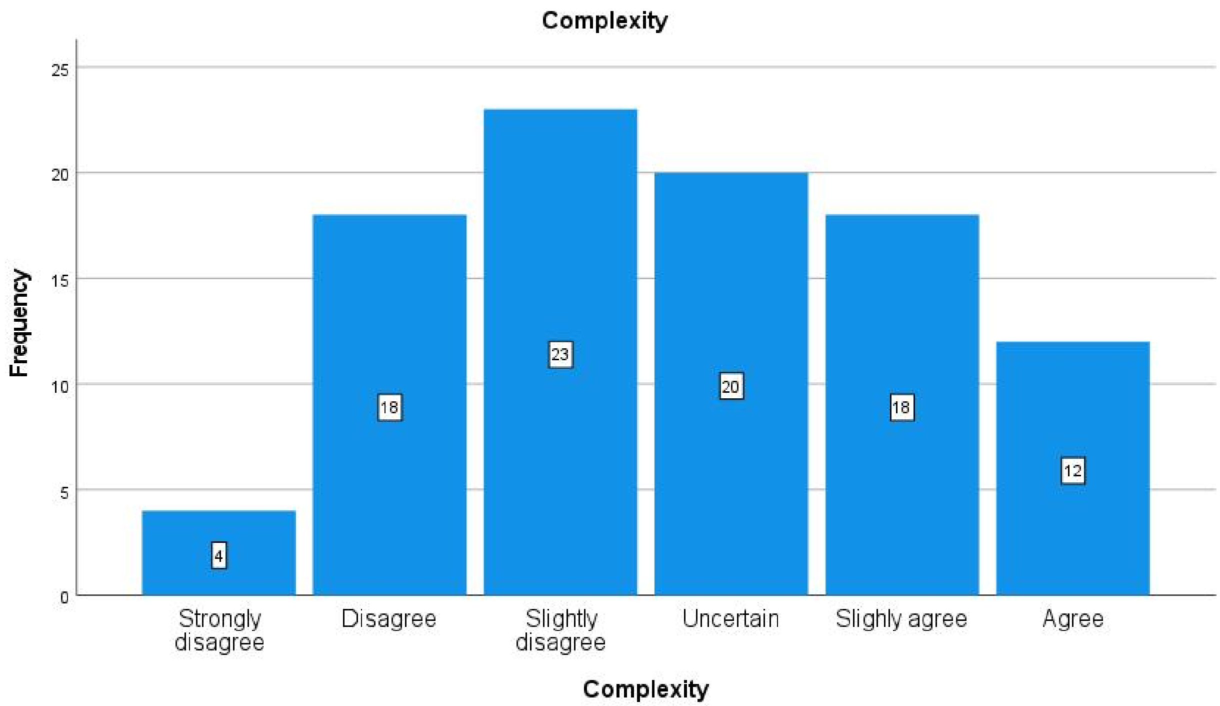

Figure 6. Descriptive results for complexity

4.9.4. Compatibility (CT)

H3: *The compatibility of the technology positively affects the intention to adopt blockchain technology.*

Regression analysis revealed that Compatibility (CT) was not a significant predictor of Intention to adopt blockchain. However, correlation analysis revealed a significant (at 0.05 level) positive association between Compatibility and Blockchain Adoption Intention (IN) as shown in Table 8, even though the relationship is weak (r=.258, p=.011). The difference between the two analyses may be the result of the combined significant correlations from the other independent variables in multiple regression, which are significantly correlated with compatibility. The variables with negative correlations are complexity (r= -.316, p= .002), and perceived cost (r= -.436, p= .000), while those with positive correlations are relative advantage (r= .357, p= .000), management support (r= .303, p= .003), customer pressure (r= .303, p= .003 and trust (r= .232, p= .023).

Furthermore, descriptive findings in Table 16 indicate that the majority (33.7%) of the respondents slightly agreed that blockchain will be compatible with the existing library systems, 28.4% agreed, 6.3% strongly agree whereas 24.2% neither agreed nor disagreed. Only 5.3% slightly disagreed with statement CT1, and 2.2% for those who disagreed and strongly disagreed. In the second question under compatibility, most of the academic librarians (40.0%) slightly agreed that blockchain will be compatible with their business processes, followed by 33.7% who agreed with **CT2**, 14.7% neither agreed nor disagreed, and 9.5% strongly agreed. For those who slightly disagreed and strongly disagreed make only 1.1%. In addition, the majority (36.8%) slightly agreed that blockchain will be compatible with their current IT architecture, with 36.8% and 5.3% agreed and strongly agreed, respectively. None of the respondents strongly disagreed, and only 1.1% disagreed and 2.1% slightly disagreed. Regarding whether libraries can connect on blockchain to share any information to form Inter-Planetary File System (IPFS), CT4, only 2.1% slightly disagreed and disagreed, while none strongly disagreed. 5.3% strongly agreed, 23.2% agreed and most respondents (42.1%) slightly agreed with the statement, CT4, whereas 25.3% did not agree nor disagreed.

Table 16. Descriptive results for compatibility items (N=95).

Response	**CT1** Blockchain technologies will be compatible with the existing library systems used.	**CT2** Blockchain technology will be compatible with library business processes.	**CT3** Blockchain technology will be compatible with the current IT architecture.	**CT4** On blockchain technology, libraries can connect to share any kind of information to form Inter-Planetary File System (IPFS).
1. Strongly disagree	1.1%	1.1%	0.0%	0.0%
2. Disagree	1.1%	0.0%	1.1%	2.1%
3. Somewhat disagree	5.3%	1.1%	2.1%	2.1%
4. Neither agree nor disagree	24.2%	14.7%	29.5%	25.3%
5. Somewhat agree	33.7%	40.0%	36.8%	42.1%
6. Agree	28.4%	33.7%	25.3%	23.2%
7. Strongly agree	6.3%	9.5%	5.3%	5.3%

In summary, the overall affirmative response (from slightly agree to strongly agree) shown in Figure 7, depicts that the majority of the respondents (42, 26 and 7) from academic libraries in

South Africa believe that blockchain technology will be compatible with their business processes, current systems, and IT architecture to be able to share predetermined information and carry out their collaborative activities. Even though descriptive results are consistent with correlation results, this study did not find compatibility (CT) as the positive predictor of intention to adopt blockchain technology, as hypothesised. The study finding contradicts the previous study by Kamble et al. (2021) whereby compatibility was found to influence the perceived usefulness of blockchain technology leading to its adoption. Gholami et al.'s (2018) study also found compatibility as a significant and positive driver of perceived usefulness and perceived ease of use of mobile technology by academic librarians in Iran. The reason for this study result was the uncertainties in blockchain compatibility with the existing systems and processes, indicated in Figure 7. Therefore, H3 was rejected and $H3_0$ was accepted.

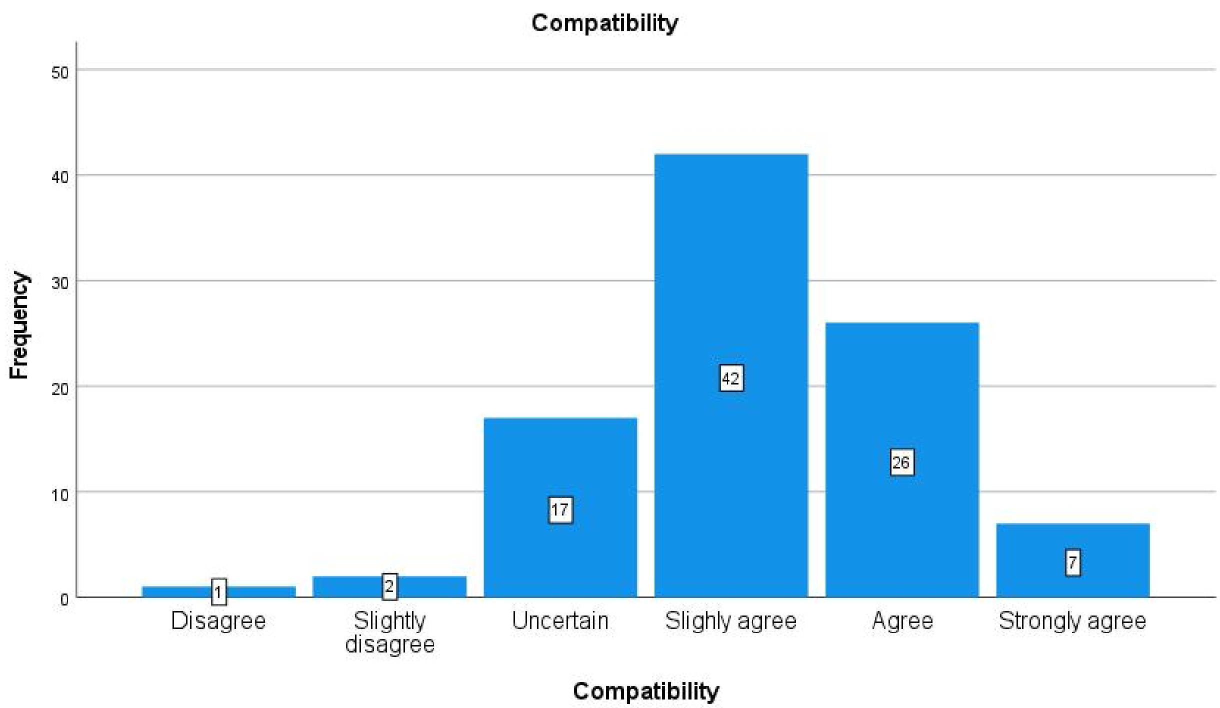

Figure 7. Descriptive results for compatibility

4.9.5. Perceived cost (PC)

H4: *The perceived cost of the technology negatively affects the intention to adopt blockchain technology.*

It was reflected in the regression analysis results (Table 11) that Perceived Cost (PC) of blockchain technology does not have significant effect on the Intention to adopt blockchain technology. The relationship was then confirmed by the Pearson's correlation analysis (Table 8) to be insignificant between these two constructs. However, the interesting revelation is that regression results show positive relationship, whereas correlation results show negative relationship. This warrants further investigation to get deeper insights about these constructs' relationship.

In terms of whether the cost of adopting blockchain will be far greater than the expected benefits, the majority (32.6%) neither agreed nor disagreed, while 30.5% slightly disagreed and 16.8% disagreed with the statement. Only 6.3% agreed with the statement and 13.7% slightly agreed. When asked whether the cost of maintaining blockchain system will be high for their libraries, most (33.7%) were not sure, whereas 15.8% disagreed. Only 5.3% agreed with the statement. 34.7% of the participants neither agreed nor disagreed when asked whether cost of supporting blockchain system will be high. 16.8% agreed, whereas only 7.4% agreed with the statement. Similarly, most of the participants (29.5%) were not sure whether cost of training to use blockchain will be high. However, 17.9% disagreed and 8.4% agreed with the statement. All this information is captured in Table 17.

Table 17. Descriptive statistics for perceived cost items (N=95).

Response	**PC1** The costs of adopting blockchain will be far greater than the expected benefits.	**PC2** The cost involved in maintaining blockchain system will be very high for our library.	**PC3** The cost involved in providing support systems for blockchain will be too high.	**PC4** The amount of money invested in training employees to use blockchain will be very high.
1. Strongly disagree	0.0%	1.1%	0.0%	1.1%
2. Disagree	16.8%	15.8%	16.8%	17.9%
3. Somewhat disagree	30.5%	23.2%	22.1%	23.2%
4. Neither agree nor disagree	32.6%	33.7%	34.7%	29.5%
5. Somewhat agree	13.7%	20.0%	18.9%	18.9%
6. Agree	6.3%	5.3%	7.4%	8.4%
7. Strongly agree	0.0%	1.1%	0.0%	1.1%

Overall, most academic librarians in South Africa are uncertain of the costs involved in adopting blockchain whether they will be high, moderate or low. Therefore, based on the unknown costs involved in blockchain technology from acquisition to the after adoption, it becomes very difficult to decide whether libraries will adopt blockchain or not. Mohammed, Potdar, and Yang (2020) in their blockchain adoption study, using netnography approach, noted that cost is a risk, and organisations are looking for solutions that mitigate risk and increase return on investment (ROI). Figure 8 shows the results of the overall perceived cost response. In this study, the results show that respondents lack awareness and knowledge about blockchain costs, which leads to the uncertainty about the intention to adopt. However, combination of responses in relation to perceived cost for blockchain adoption for those who disagree (14) and slightly disagree (25), though at different levels of disagreement, dominates 31 responses for those who were uncertain, and 25 for those who agree (from slightly agree (19) and agree (6)). Based on regression, and correlation results, this study suggests that cost is not an important predictor of intention to adopt blockchain, which is inconsistent with the previous studies (Lin, 2014; Maduku et al., 2016; Wong, Leong, et al., 2020) which established negative relationship between innovation cost and its adoption intention. The explanation for this result has been found to be lack of awareness, knowledge, experience and expertise on blockchain technology. Although staff training is considered to be a very important aspect in successful implementation of new technology, associated costs may act as the barrier to adoption intention if they are not well understood (Lin, 2014). Blockchain service providers therefore can overcome this challenge by educating and communicating current developments in blockchain technology relative to its cost, so that cost uncertainty can be eliminated as the barrier to blockchain adoption intention. The existence of cloud-based blockchain platforms offered as a service by technology companies such as IBM, AWS, Microsoft, SAP and others, enable organisations and individuals to develop blockchain applications, using existing tools at a minimal cost (Clohessy & Acton, 2019) without building their own infrastructure from the ground. These platforms do not require too much in terms of investments to start developing blockchain proof of concepts. Academic libraries may, therefore consider this option to expedite development of proof of concepts. Hypothesis, H4 was therefore, rejected, and null hypothesis, $H4_0$ was accepted.

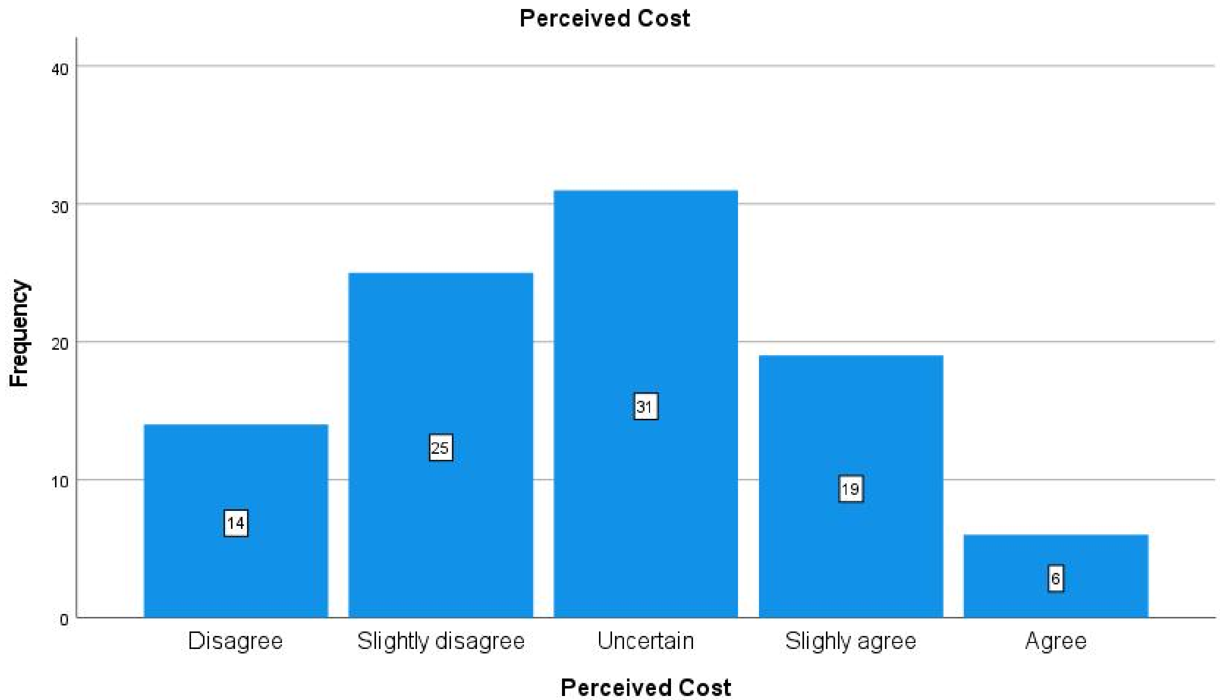

Figure 8. Descriptive results for perceived cost

4.9.6. Organisational size (Size)

H5: *The size of the organisation positively affects the intention to adopt blockchain technology.*

The regression analysis indicated that Organisational Size (OS) is insignificant in terms of influencing the Intention to adopt blockchain technology. Correlation analysis results reflect insignificant association as well, with the Intention to adopt blockchain. Both of these analyses results show negative relationship with the intention to adopt blockchain, which is against the hypothesised statement, **H5**.

All respondents were from the large institutions in South Africa, which are characterised by the existence of financial resources, technology infrastructure and expertise (Lin, 2014). The results of the study show that organisational size does not significantly affect the intention to adopt blockchain technology, probably because dominant participants were LIS professionals who are characterised with lack of technological innovation desire/enthusiasm in developing countries (Weiner & Coetsee, 2013). The study does not support prior literature (Lin, 2014) which underscores organisational size as an important positive predictor of intention to adopt new technology. Another possible explanation for this study result is that large organisations are clouded with multiple levels of bureaucracy, which results in prolonged process of decision making in adopting innovation. Therefore, H5 was rejected and $H5_0$ was accepted.

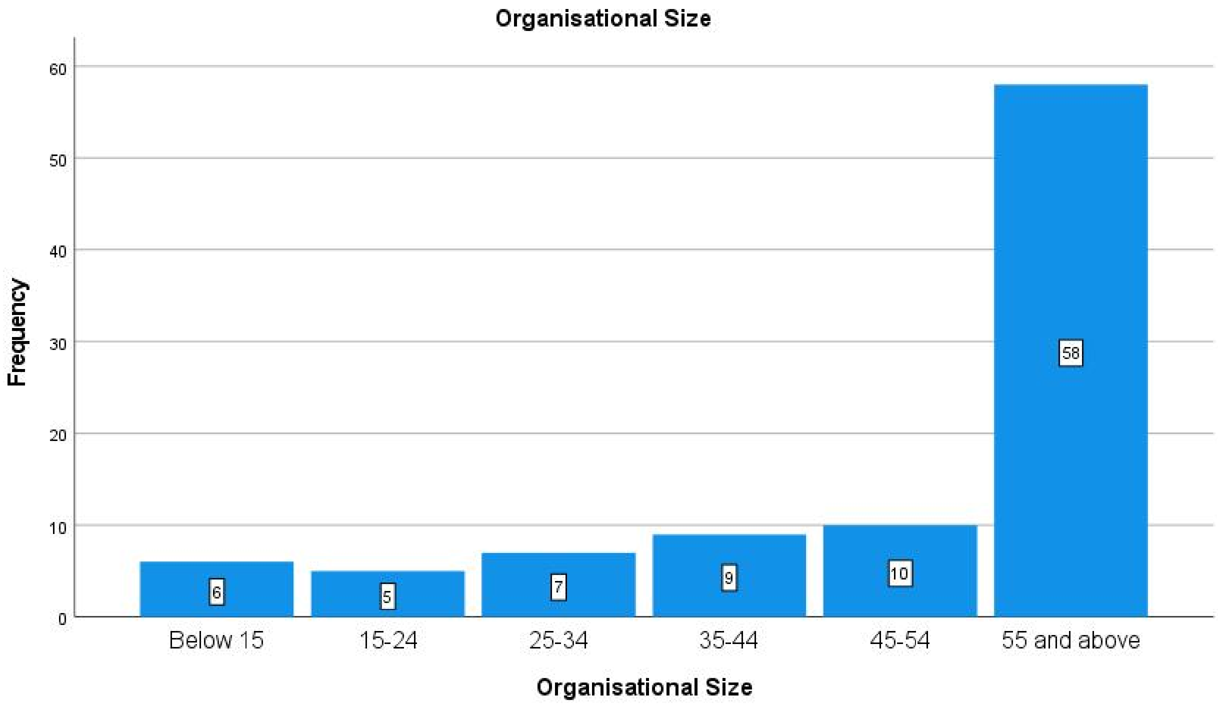

Figure 9. Descriptive results for size of the library

4.9.7. Management support (MS)

H6: *The management support of the new technology positively affects the intention to adopt blockchain technology*.

According to the regression analysis results, there was no significant relationship between Management Support (MS) and Intention to adopt blockchain. However, correlation analysis shows a significant (at $p<.05$ level) positive relationship between these constructs although it is weak ($r=.265$, $p=.009$). Even though there is no significant influence in the relationship, results from both analyses show positive association, which is consistent with the hypothesis (H6). The difference in the two analyses may be attributed to the contribution from other independent variables in multiple regression, which are significantly correlated with management support. These variables are complexity ($r= -.395$, $p= .000$), and perceived cost ($r= -.296$, $p= .004$) with negative correlations, while compatibility ($r= .303$, $p= .003$), IT readiness ($r= .446$, $p= .000$), customer pressure ($r= .329$, $p= .001$), and industry support ($r= .337$, $p= .001$) have positive correlations.

The descriptive findings for management support are shown in Table 18. From the results, it was evident that respondents (44.2%) were not sure whether their top management would provide the necessary support for blockchain adoption, with only 13.7% of library staff members being certain that management will provide the support for the adoption of blockchain (10.5% agreed and 3.2% strongly agreed). 27.4% slightly agreed, while 10.5% slightly disagreed that management would provide support for blockchain adoption. Similarly, when asked about whether management will provide resources for blockchain, 42.1% were still not sure, 15.8% (13.7% agreed and 2.1% strongly agree) absolutely agreed. Academic libraries were also asked whether top management will support the use of blockchain technology. 33.7% were not sure, 33.7% slightly agreed and 20% (16.8% and 3.2%) agreed.

Table 18. Descriptive results for management support items (N=95).

Response	**MS1** Top management will provide necessary support for blockchain technology adoption.	**MS2** Top management will provide resources necessary for blockchain technology adoption.	**MS3** Top management will support the use of blockchain technology.
1. Strongly disagree	0.0%	1.1%	0.0%
2. Disagree	4.2%	3.2%	4.2%
3. Somewhat disagree	10.5%	9.5%	8.4%
4. Neither agree nor disagree	44.2%	42.1%	33.7%
5. Somewhat agree	27.4%	28.4%	33.7%
6. Agree	10.5%	13.7%	16.8%
7. Strongly agree	3.2%	2.1%	3.2%

Overall, according to the bar chart shown in Figure 10, academic libraries (37) were not sure whether their top management will offer support for blockchain adoption, while 31 slightly agreed that management support will be provided for blockchain adoption. Although it was realised that academic libraries were aware of potential benefits of blockchain in this study, lack of awareness of the risks, costs implications and skills set requirements associated with blockchain technology, may render top management to be undecisive as to whether to support blockchain adoption or not. However, combination of positive response (slightly agree (31), agree (13), strongly agree (2)) for top management support, dominates uncertain response and negative response (slightly disagree (9), disagree (3), strongly disagree (0)), which suggests that top management support may be considered in blockchain adoption. However, according to the regression results, the study finding does not support the previous studies in innovation adoption (Clohessy & Acton, 2019; Maduku et al., 2016). Top management support was found to positively influence the adoption intention by Maduku et al.'s (2016) study in mobile marketing innovation among the SMEs, and Clohessy and Acton's (2019) study in influencing organisational factors in blockchain adoption by Irish companies. "If top management became more knowledgeable about the innovation and its benefits, they would be more likely to develop a positive adoption intention and also support its adoption"

(Maduku et al., 2016, p. 718). Because of the uncertainty of the respondents for top management support for blockchain adoption, institutional plans to implement or adopt blockchain any time soon may be affected. However, some respondents are positive about management support in adoption of blockchain, though they differ in extent of agreement. This study finding may be attributed to the fact that most South African academic libraries are underfunded below the recommended benchmark of 6% of the institutional budget because of inflation (Hoskins & Stilwell, 2011), hence any costs in the academic libraries may not have management support. It is, therefore, advisable for academic libraries to regularly communicate their aims and strategic plans to the top management in order to be clear of what may be supported, and what may not be, that contributes to the institutional aims. Therefore, H6 was rejected and $H6_0$ was accepted.

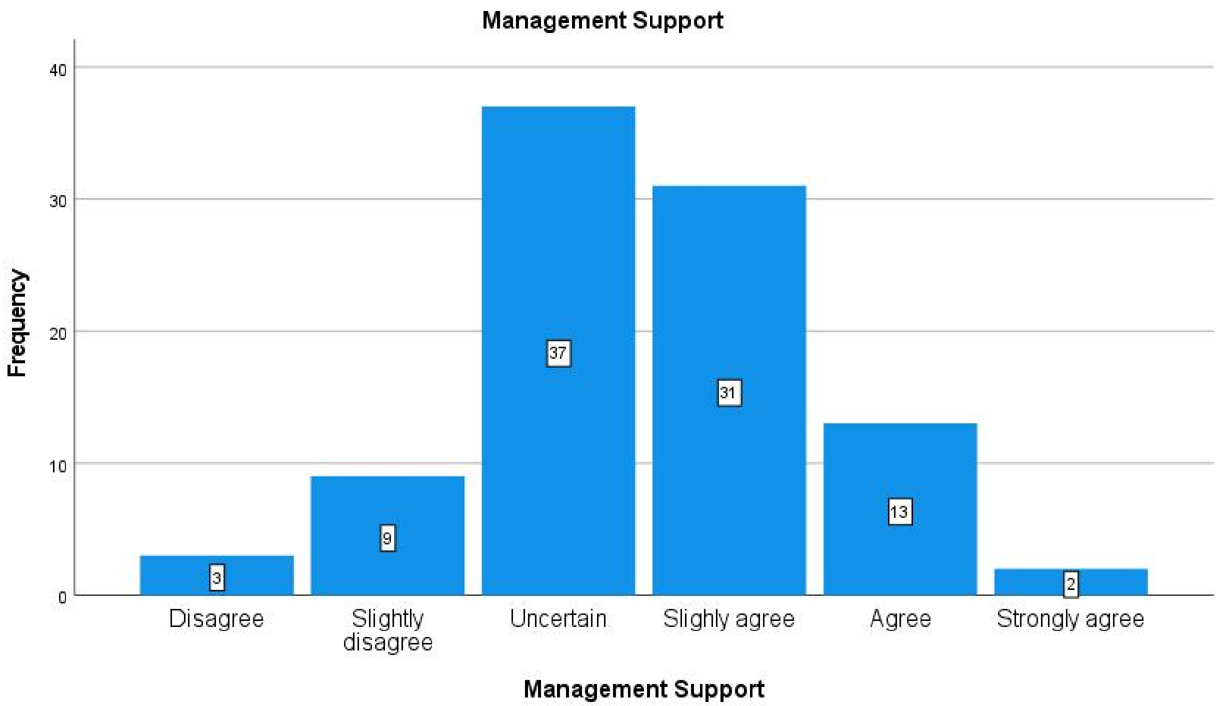

Figure 10. Descriptive results for management support

4.9.8. IT Readiness (IR)

H7: *IT readiness positively affects the intention to adopt blockchain technology.*

The regression analysis results show non-significant influence of IT Readiness (IR) on Intention to adopt blockchain (IN), meaning there is no predictive power between the two variables. This was further confirmed by correlation analysis that there is no significant association between these two variables. However, regression result shows a negative relationship, whereas correlation result shows a positive association.

As shown in Table 19, 42.1% of respondents slightly agreed that their libraries have enough resources to implement blockchain technologies and 27.4% absolutely agreed that they have resources. Regarding whether their libraries have employees who can learn the use of blockchain technologies easily, 51.6% slightly agreed, with 37.9% who fully agreed. In addition to that, 48.4% of respondents also slightly agreed that there are employees who can provide new ideas on the blockchain use for their libraries, while 34.8% (29.5% and 5.3%) were absolutely sure. When asked whether in case of blockchain related difficulties there is a person or group who can assist, 30.5% (26.3% agreed and 4.2% strongly agreed) absolutely agreed, 20.0% neither agreed nor disagreed, and 18.9% slightly agreed.

Table 19. Descriptive results for IT readiness items (N=95).

Response	**IR1** Our library has the necessary resources to implement blockchain technologies.	**IR2** Our library has employees who can learn the use of blockchain technologies easily.	**IR3** There are employees who can provide new ideas on blockchain use for our library.	**IR4** There is a specific person (or a group of employees) available to assist in case of blockchain-related difficulties.
1. Strongly disagree	0.0%	0.0%	0.0%	3.2%
2. Disagree	8.4%	2.1%	2.1%	15.8%
3. Somewhat disagree	5.3%	4.2%	6.3%	11.6%
4. Neither agree nor disagree	16.8%	4.2%	8.4%	20.0%
5. Somewhat agree	42.1%	51.6%	48.4%	18.9%
6. Agree	23.2%	33.7%	29.5%	26.3%
7. Strongly agree	4.2%	4.2%	5.3%	4.2%

The overall response about IT readiness is shown in Figure 11, and the majority of the respondents, 46.3% (44) slightly agreed that their libraries have the required expertise and resources to implement blockchain technology, and 23.2% (22) agree that they are ready in terms of resources and expertise. 18.9% (18) have no idea whether their libraries are ready to implement blockchain with the expertise and resources they have. A significant number of respondents are positive about the IT infrastructure, and technical expertise they have, to enable integration of blockchain into their systems and processes. However, a significant number (18.9%) of respondents also show uncertainty in terms of IT readiness in their institutions. This behaviour may have been brought by lack of awareness and knowledge about blockchain that affect perception about IT readiness. This study is not consistent with many previous studies that have found organisations' IT readiness to positively influence the technology adoption intention (Azmi, Abdullah, Bakri, Musa, & Jayakrishnan, 2018; Gökalp et al., 2020; Maduku et al., 2016). The implication is that among other considerations, top management must give enough attention to IT infrastructure, and develop expertise in their key staff members, to eliminate the uncertainty in the IT Readiness of the libraries. H7 was therefore, rejected and $H7_0$ was supported.

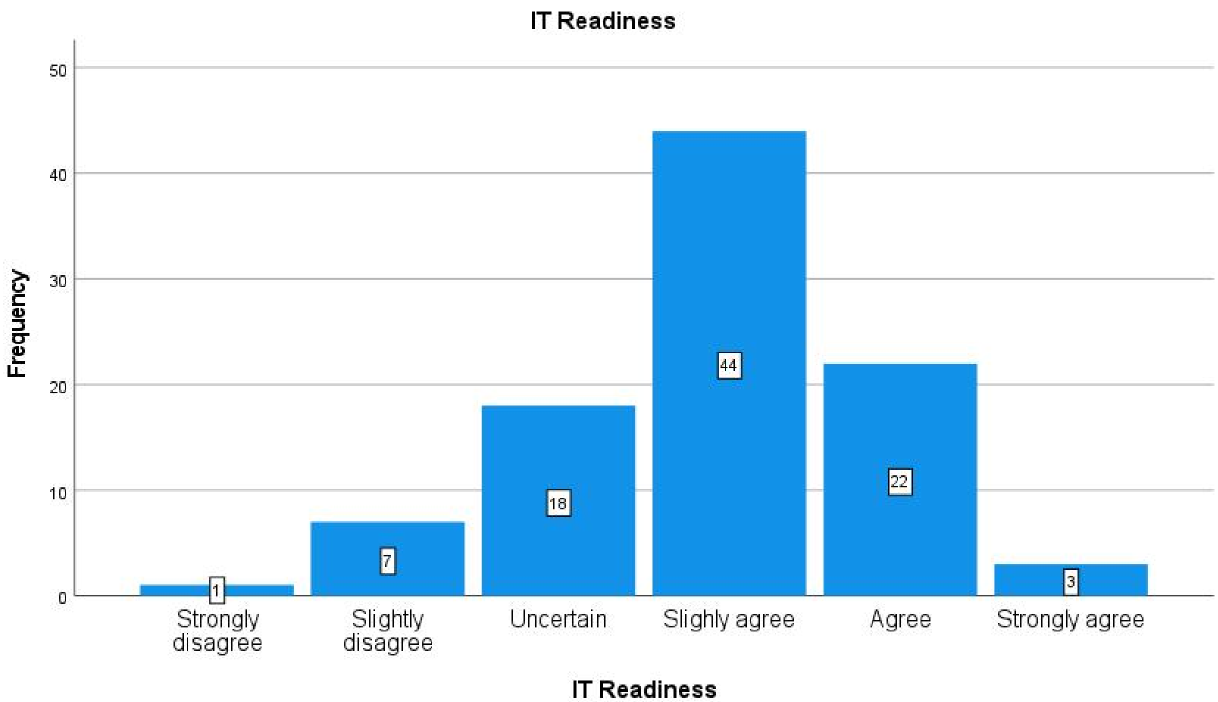

Figure 11. Descriptive results for IT readiness

4.9.9. Industry support (IS)

H8: *The industry support of the new technology positively affects the intention to adopt blockchain technology.*

Regression analysis results revealed that Industry Support (IS) does not have significant influence on the Intention to adopt blockchain technology (IN). The relationship was further confirmed by the Pearson's correlation analysis results to be insignificant between these constructs. In both analyses, positive insignificant relationship was identified. H8 was rejected, and $H8_0$ was accepted.

Table 20 shows responses for IS items. When asked whether there will be adequate support for blockchain from the service providers, the majority (51.6%) were not sure, whereas 20.0% slightly agree to the statement, 15.8% agreed. Regarding the question whether training for blockchain will be adequately provided by service providers through library consortia support, similarly, 52.6% were not sure, 18.9% slightly agreed and 16.8% agreed that there will be adequate training.

Table 20. Descriptive results for industry support items (N=95).

Response	**IS1** There will be adequate technical support for blockchain provided by blockchain services providers.	**IS3** Training for blockchain technology will be adequately provided by service providers with support from the library consortia.
1. Strongly disagree	0.0%	0.0%
2. Disagree	4.2%	4.2%
3. Somewhat disagree	6.3%	5.3%
4. Neither agree nor disagree	51.6%	52.6%
5. Somewhat agree	20.0%	18.9%
6. Agree	15.8%	16.8%
7. Strongly agree	2.1%	2.1%

The overall response to the industry support reflects that, academic libraries in South Africa are not sure whether they will be provided with adequate training and support from blockchain service providers, library consortia and other external stakeholders in terms of regulations and established industry standards for safe practices and interoperability if they adopt blockchain technology. This is shown in Figure 12 whereby 45 is reflective of the majority of the respondents who are uncertain of the industry support.

Thong (2001) found external expertise from vendors to be key in successful information systems implementation. Similarly, MacLennan and Van Belle (2014) found industry support for integration and development tools to be significant in service-oriented architecture implementation in South Africa. This study result is likely to impede the implementation success of blockchain since potential users are not sure of the facilitating conditions such as industry support to adopt this technology. "Firms that possess the right facilitating conditions are more likely to adopt BCSCM [Blockchain in Supply Chain Management]" (Wong, Tan, et al., 2020, p. 2114). However, due to belief in the presence of IT capabilities indicated by the respondents in this study, industry support may not be considered a key determinant of blockchain adoption intention. Industry support is relied upon when the knowledge base about the technology within an institution is considered not enough (Maduku et al., 2016). Due to the existence of technology infrastructure, and employees with the necessary skills to use and support blockchain technology, industry support would not be critical in determining academic libraries' intention to adopt blockchain. H7 was therefore, rejected and $H7_0$ was supported.

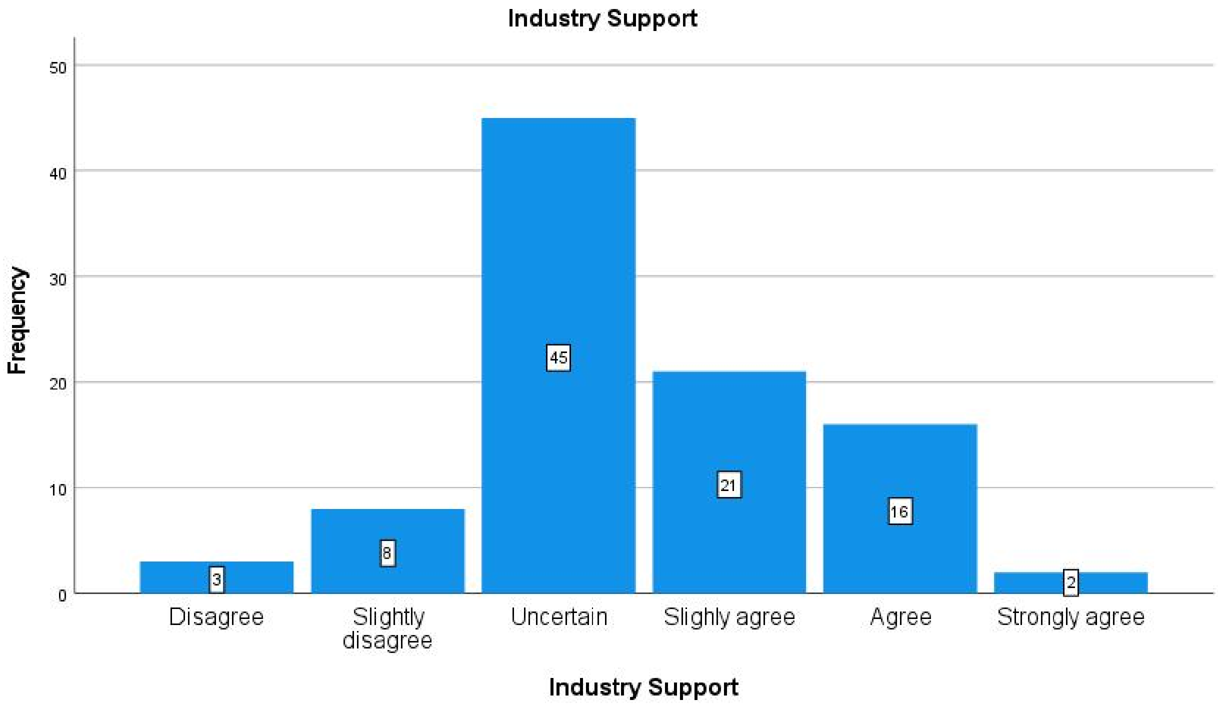

Figure 12. Descriptive results for industry support

4.9.10. Customer pressure (CP)

H9: *The customer pressure positively affects the intention to adopt blockchain technology.*

Regression analysis results indicated that Customer Pressure (CP) is the significant predictor variable of the Intention to adopt blockchain technology (IN) with regression coefficient of 0.303 at 0.005 level (highly significant, $p<.01$) and t-value of 2.918 which is significantly different from zero (0). The relationship was then confirmed by the Pearson's correlation analysis to be highly significant ($p<.01$) between these constructs.

The participants were asked questions related to customer pressure (CP). As shown in Table 21, most of the participants (29.5%) neither agreed nor disagreed to a fact that many of their customers will expect their library to adopt blockchain to eliminate duplication of efforts, 23.2% slightly agreed, and over 28% (agreed and strongly agreed) were sure that customers will expect libraries to adopt blockchain. Only 6.4% (1.1 disagreed and 5.3% disagreed) disagreed with statement, while 12.6% slightly disagreed. When asked whether their relationship with their customers will suffer when they do not adopt blockchain, 34.7% (majority) were not sure, while over 14% disagreed and just above 16% agreed. Most (33.7%) slightly agreed that their customers will consider them to be forward thinking if they adopt blockchain technology, while 23.25 are not sure. Over 28% believe that they will be forward thinking, and less than 4% disagreed. 11.6% slightly disagreed.

Table 21. Descriptive results for customer pressure items (N=95).

Response	**CP1** Many of our customers will expect our library to adopt blockchain technology to eliminate duplication of efforts.	**CP2** Our relationship with our customers will suffer if we do not adopt blockchain technology.	**CP3** Our customers will consider us to be forward thinking by adopting blockchain technology.
1. Strongly disagree	1.1%	3.2%	1.1%
2. Disagree	5.3%	11.6%	2.1%
3. Somewhat disagree	12.6%	18.9%	11.6%
4. Neither agree nor disagree	29.5%	34.7%	23.2%
5. Somewhat agree	23.2%	14.7%	33.7%
6. Agree	24.2%	14.7%	25.3%
7. Strongly agree	4.2%	2.1%	3.2%

When considering the overall response of the participants regarding whether customer pressure will influence academic libraries' adoption of blockchain, 34.7% (33) had no idea, 27.4% (26) slightly agreed. 16.8% of respondents agreed, 3.2% strongly agreed, while just above 17% showed disagreement with the statement. Considering combination of the numbers for those who were positive (47.3%), neutral (34.7%) and negative (17.4%) towards customer pressure being an important factor to adopt blockchain in academic libraries, positive response dominates other responses. Although, notable responses indicated some uncertainty towards customer pressure, it was found to positively influence the intention to adopt blockchain technology in South African academic libraries. This is consistent with the previous research of Maduku et al. (2016) that established a positive influence of customer pressure on intention to adopt mobile marketing. The possible reason being academic libraries are customer-driven and strive to deliver their services in a novel and convenient way from wherever they are. The lure to provide these services in a novel way, can be used by blockchain service providers by marketing their products to influence positive intention towards blockchain adoption by academic libraries. Therefore, H9 was accepted and $H9_0$ was rejected.

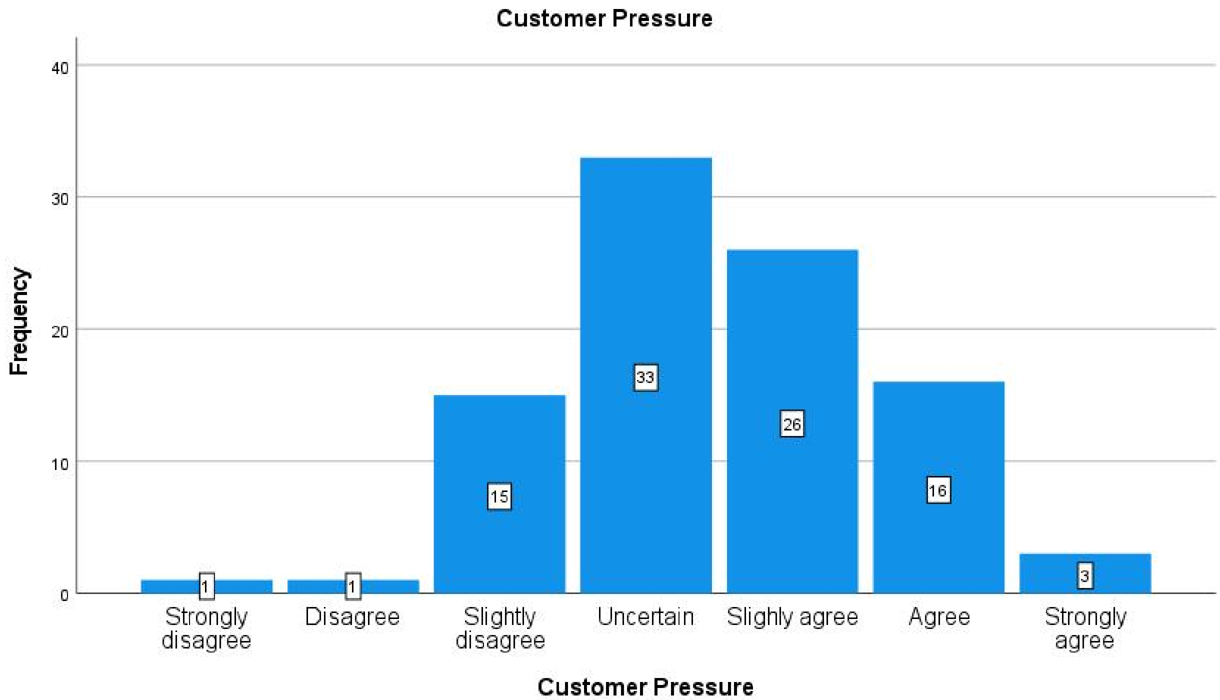

Figure 13. Descriptive results for customer pressure

4.9.11.Security and privacy concern (SC)

H10: *Security and privacy regulatory concern negatively affects the intention to adopt blockchain technology.*

It was revealed in the regression analysis results that Security Concern (SC) has a statistically insignificant effect on the Intention to adopt blockchain technology (IN). Similarly, correlation analysis results confirm non-significant negative relationship between these two constructs.

Considering descriptive statistics results for SC items in Table 22, the majority (33.7%) seem to have no idea whether adherence to security standards and privacy relations, will be a challenge with blockchain technology adoption or not. 24.2% make up those who slightly agreed with **SC1**, while 16.8% and 3.2% agreed and strongly agreed, respectively. Only 14.7%, 6.3% and 1.1% of the respondents slightly disagreed, disagreed, and strongly disagreed with the statement, SC1. Similarly, most (34.7%) respondents have no idea whether it will be harder to assess compliance of all personal data recorded on blockchain with requirements of data protection law, while 30.5% slightly agreed and 20.0% agreed. When asked whether there will be a concern of legal implication to non-compliance to security standards and privacy regulations with the use of blockchain, 33.7% had no idea, 28.4% slightly agreed, while 23.2% agreed that there will be a concern.

Table 22. Descriptive results for security and privacy items (N=95).

Response	**SC1** Adherence to security standards and privacy relations will be a challenge with blockchain technology.	**SC2** It will be harder to assess compliance of all personal data recorded on blockchain with the requirements of data protection law.	**SC3** With the use of blockchain, there will be a concern of legal implication to non-compliance to security standards and privacy regulations.
1. Strongly disagree	1.1%	1.1%	0.0%
2. Disagree	6.3%	3.2%	3.2%
3. Somewhat disagree	14.7%	9.5%	8.4%
4. Neither agree nor disagree	33.7%	34.7%	33.7%
5. Somewhat agree	24.2%	30.5%	28.4%
6. Agree	16.8%	20.0%	23.2%
7. Strongly agree	3.2%	1.1%	3.2%

The majority 37.9% (36) of the respondents lies within the range of those who had no idea whether data security and privacy will be a concern on blockchain or not, while 28.5% (27) slightly agreed.

Although most of the participants realise the potential benefits of blockchain technology to their institutions and profession, academic libraries are not sure whether security and privacy of their data will be maintained if they adopt this technology. However, combined responses for those who are on the affirmative side (50.7%) dominate other responses (uncertain (37.9%) and negative (11.6%)). Wong, Leong, et al.'s (2020) findings indicated that data security and privacy have remained the challenges to blockchain adoption, hence proper regulations and policies need to be developed for the use of this technology because of early stages of its development. However, regulators have to consider and address the conflict between regulatory regimes and technology advancement (Wong, Leong, et al., 2020). The possible explanation for this study result is the uncertainty surrounding blockchain technology in terms of data security and privacy concern. Because of regression and correlation results, H10 was rejected, and $H10_0$ was accepted.

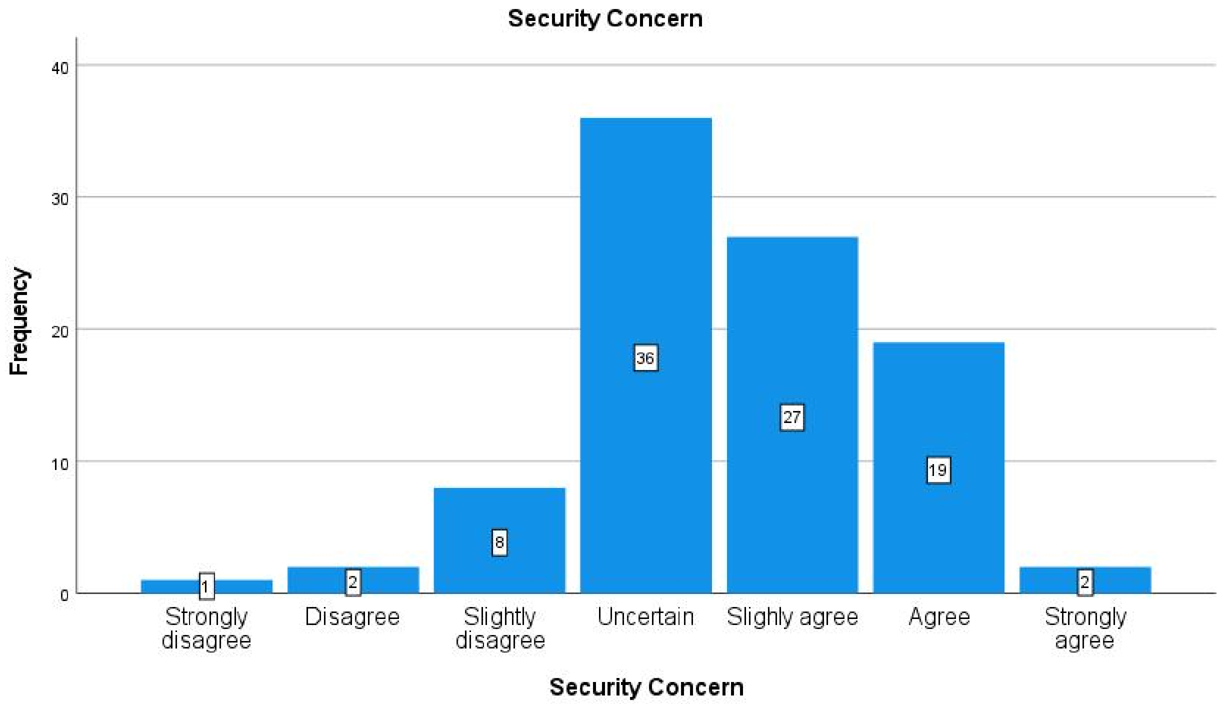

Figure 14. Descriptive results for security and privacy concern

4.9.12.Trust (TR)

H11: *The level of trust between partners positively affects the intention to adopt blockchain technology.*

The level of Trust (TR) was shown to have insignificant influence on the Intention to adopt blockchain technology (IN) in the regression analysis results in Table 11. The similar positive association was also confirmed by the correlation analysis to be insignificant between these constructs in Table 8.

However, according to the descriptive findings of trust (TR) shown in Table 23, it is evident that most respondents (31.6% slightly agreed, 40.0% agreed and 8.4% strongly agreed) trust their library consortia members, while only 1.1% did not have trust at all. 12,6% of the respondents were not sure whether to trust their consortia members or not. When asked whether they trust their consortia members to keep their best interest in mind, the majority (40.0% agreed and 11.6% strongly agreed) agreed with the statement, while 9.5% were not sure whether to trust or not, and only 1.1% had not trust. Moreover, most of the respondents (42.1% and 13.7%) trust that their partnerships with other academic libraries will fulfil their obligations, with 1.1% who strongly disagreed and 11.6% who were not sure whether to trust them or not.

Table 23. Descriptive results for trust items (N=95).

Response	**TR1** I think we can trust academic libraries consortia members.	**TR2** We trust academic libraries consortia members to keep our best interest in mind.	**TR3** We trust our partnerships with other academic libraries will fulfil our obligations.
1. Strongly disagree	1.1%	1.1%	1.1%
2. Disagree	0.0%	0.0%	0.0%
3. Somewhat disagree	6.3%	1.1%	1.1%
4. Neither agree nor disagree	12.6%	9.5%	11.6%
5. Somewhat agree	31.6%	36.8%	30.5%
6. Agree	40.0%	40.0%	42.1%
7. Strongly agree	8.4%	11.6%	13.7%

Although regression and correlation results show insignificant relationship between trust and intention to adopt blockchain, it is evident according to the descriptive results in Figure 15, that the majority (over 80%) of the respondents trust their partnerships in library consortia will deliver according to their expectations. For any collaborative technology to be adopted, trust between the participating partners becomes very important for successful adoption and use (Wong, Tan, et al., 2020) because it is a strategic decision that requires thorough evaluation of advantages and disadvantages (Liu et al., 2015). Blockchain is a technology whose benefits are best realised at an ecosystem level, not within the borders of the individual institutions. Fortunately, academic libraries have a long history of partnership (Wilding, 2002) which supposedly makes it easier when a shared technology like blockchain has to be collectively acquired for the reciprocal gains. Wong, Tan, et al. (2020) in their study about blockchain adoption factors in supply chain management in Malaysia, found inter-organisational trust to be an inhibitor of blockchain implementation. For this study, inter-organisational trust was perceived to exist, though with no influential relationship to the intention to adopt blockchain. H11 was therefore, rejected and $H11_0$ was supported.

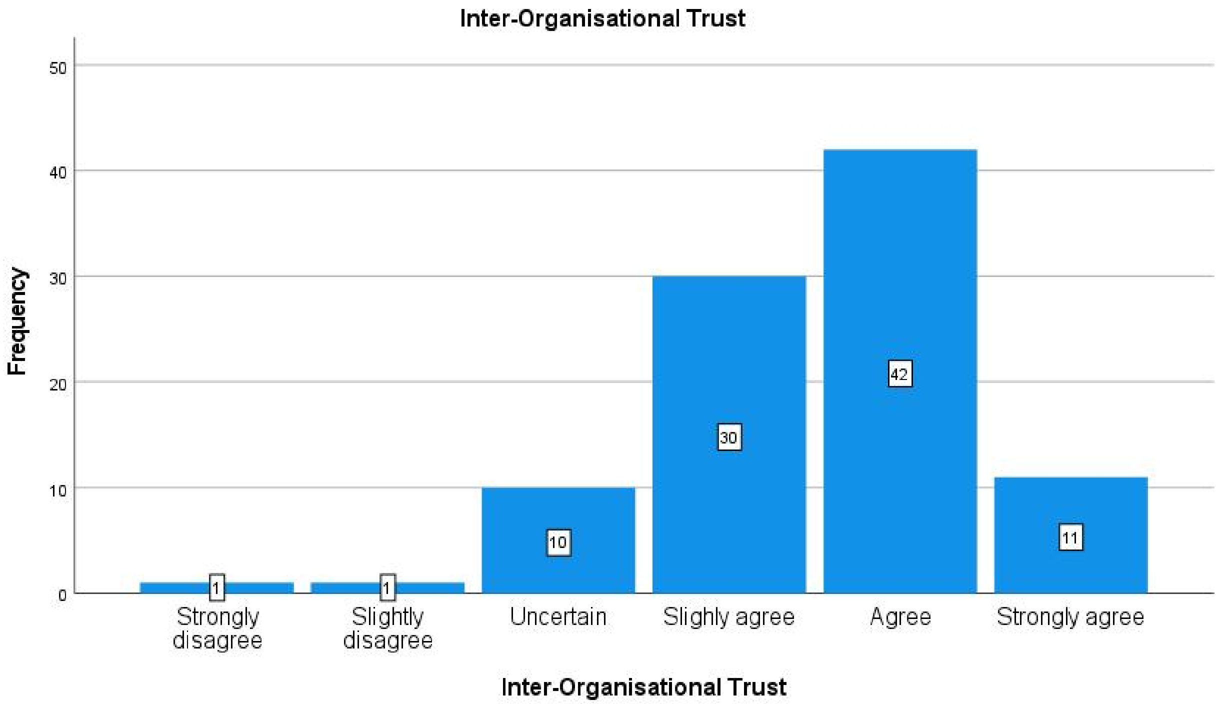

Figure 15. Descriptive results for trust

CHAPTER 5 : CONCLUSIONS

5.1. Introduction

In this chapter, the researcher begins by reviewing the research questions, and conclusions are drawn from the findings discussed in the previous chapter. Following conclusion, are the implications and limitations of the study, provided together with the direction for further research.

5.2. Summary of findings

Academic libraries are characterised by a long history of collaboration, yet their individual systems still operate in silos. This results in duplication of effort among the academic libraries, which negatively impacts their performance. To enable collaborative activities, a third party is normally involved for coordination, which attracts costs, and introduces a single point of failure risk. To address these challenges, academic libraries have to rethink their strategy in offering their services to their clients seamlessly, without failure, at minimal costs. Blockchain, among other emerging technologies, has attracted interest from different industries because of its features and potential to disrupt business models. The status of blockchain technology development in South African academic libraries has proven to be non-existent. However, Western world libraries have started to explore the application of this technology in library and information profession, through the project undertaken by San Jose State University (Huwe, 2019). Academic libraries, therefore, should not stay behind lest they become obsolete and outcompeted by other information rivals. To the best of the researcher's knowledge, no empirical study has been carried out about blockchain adoption in the context of academic libraries, hence the motivation for this study. The main objectives of this study were to explore the potential applications of blockchain, perceptions on intention to adopt, perceptions on adoption factors, and influencing factors in adoption intention of blockchain technology by academic libraries in South Africa. The TASC framework was adapted as a lens to answer the following question:

"Why academic libraries intend to adopt blockchain technology for their collaborative business processes in South Africa?"

To answer the research question, the following sub-questions were formulated:

1. What are the potential applications of blockchain technology in academic libraries?
2. What are the academic libraries' perceptions of intention to adopt blockchain?
3. What are the academic libraries' perceptions of blockchain technology adoption factors?
4. What are the factors that influence the intention to adopt blockchain technology for academic library collaborative processes?

5.2.1. Potential applications of blockchain in academic libraries (RQ1)

Blockchain technology has found diverse applications in different industries. In the context of academic libraries, potential applications of blockchain technology were found to be in distributed metadata sharing, a shared credentialing system, and a library network connection to form IPFS. Through distributed blockchain technology, metadata sharing of the academic libraries' holdings can be enabled on the platform, eliminating coordination costs currently incurred by using OCLC. Duplication of records will be eliminated as patrons will be able to get authorised access to resources from the participating libraries through secure credentialing system. IPFS can also facilitate peer-to-peer file sharing on a blockchain platform between the library network members.

5.2.2. Perceptions of intention to adopt blockchain (RQ2)

Although there may be a wide range of variables that influence the adoption intention of blockchain technologies, based on the TASC model, eleven hypotheses were derived from the model constructs, which were expected to significantly influence the blockchain adoption intention. The constructs are relative advantage, complexity, compatibility, perceived cost, organisational size, management support, IT readiness, industry support, customer pressure, security concern, and inter-organisational trust. Descriptive statistics, multiple regression model and correlation results were used to assess these factors, and potential applications affecting adoption intention of blockchain technology. However, it was found that participants are clouded with uncertainty of whether their academic libraries are intending to adopt blockchain or not.

5.2.3. Perceptions of blockchain technology adoption factors (RQ3)

Although, most variables did not have significant impact on the intention to adopt blockchain, descriptive results suggest that academic libraries have positive perceptions of technology characteristics (relative advantage, compatibility), organisational characteristic (IT readiness) and inter-organisational relationship (trust) in integrating blockchain in their business processes. They are uncertain, to slightly negative about the cost of blockchain, and slightly negative to uncertain about its complexity in technology context. Their perceptions towards organisational context (management support), and environmental context (industry support, customer pressure, security concern) are uncertain to slightly positive on blockchain technology. All the respondents are from the large institutions, which are deemed to have more resources that enable them to absorb the risks associated with new technologies. It is therefore, presumed that academic libraries are partially positive, uncertain, and slightly negative about technology characteristics of blockchain. In terms of organisational characteristics of blockchain, they are partially positive, and uncertain. Regarding environmental context, they are uncertain about blockchain technology, probably because of blockchain standards which are still in the infancy stage, and the uncertainty about the blockchain regulations. Academic libraries perceive inter-organisational trust to be existent among their partners, which makes them believe their interests will be served if blockchain gets integrated in their processes.

5.2.4. Determinant factors of blockchain adoption intention (RQ4)

Correlation results indicated significant relationship between independent variable, blockchain adoption intention, and dependent variables, compatibility, management support and customer pressure. However, when all the eleven adoption factors were included in the regression model, only customer pressure in environmental context was found to be significant in influencing the intention to adopt blockchain by academic libraries in South Africa.

5.3. Concluding remarks

Although studies on adoption of blockchain in library and information sector are quite recent, the findings provide essential information that may need to be explored further by vendors and information managers involved in blockchain adoption projects. This includes consideration of the infrastructure and education of the organisations intending to adopt. For example, participants were aware, though at low level, of the applications and benefits of the blockchain in academic libraries, yet they were not intending to adopt because of little knowledge of what the technology may require to facilitate its adoption. However, despite the low level of infrastructure and knowledge in emerging economies, customer needs are centric to academic libraries' effective and efficient service deliveries. Based on the low R^2 value obtained in the regression model, the TASC model was found to be inefficient in explaining the influencing factors of intention to adopt emerging technologies, especially where the sample size is low, and the participants are not knowledgeable about the technology.

5.4. Implications

Lack of experience, knowledge, and expertise with blockchain technology was found to be dominant among the study respondents, who were characterised by a lot of uncertainty in their perceptions towards blockchain adoption intention in their processes. This means that there is slow market penetration and lack of awareness of blockchain technology in the academic libraries sector, as it has been pointed out that library professionals lack enthusiasm towards new technologies, especially in the African countries (Masenya & Ngulube, 2021). Therefore, through this study, academic libraries are sensitised of the complex blockchain technology and the potential value it holds for them, to stay abreast of the technology change, and avoid failure and irrelevance. It is suggested that top management, together with the industry stakeholders (library associations, consortia, and vendors), devote their efforts in ensuring that academic libraries are equipped with the right infrastructure, resources, and expertise in exploring blockchain technologies.

There is no practical experience and implementation of blockchain in South African universities' libraries. To evaluate the potential of blockchain technology, it is suggested that cloud-based blockchain as a service be considered for creating a distributed metadata system, and a credentialing system to connect different libraries and maintain digital rights of the shared information. In this study context, consortium blockchain can be adopted to include only the academic libraries consortia members, with predetermined members to participate in the consensus process. This will ensure that security and privacy issues of the data shared on the platform are addressed, as they are perceived to be concerning to the academic libraries' respondents. Because of the uncertainty about blockchain technology, this calls for urgent development of standards and regulations. Security policies should be in place to protect unauthorised access to the confidential information shared on the platform. "This can be achieved via regulatory guidance on the application of BC [blockchain] to various data protection regulations that could provide more certainty and transparency to the use of data" (Wong, Tan et al., 2020, p. 2115).

Blockchain research is mostly in the form of literature review, and conceptual in nature, especially in the library and information services context. This study contributes to the ever-growing blockchain literature, by providing empirical evidence from the developing economy using the TASC model and adds diversity to the innovation adoption models. The TASC framework used in this study, extends TOE by adding the inter-organisational relationship perspective for inter-organisational technology adoption which addresses complexity of inter-organisational environment. This study responds to the call that was made by Asare et al. (2016) to empirically test the TASC model. Wong, Leong et al. (2020) also stressed that further studies in blockchain need to be carried out to assess the impact of data security and privacy in blockchain adoption using the extended TOE framework to add insights to their study findings. According to the researcher's knowledge, this is one of the first few studies on blockchain adoption intention by academic libraries in a developing country that empirically tested the TASC framework, as an extension of TOE to include the relationship perspective. The current study, therefore, bridges the gap in the literature and contributes to the knowledge on technology adoption by providing empirical evidence on blockchain technology adoption intention in academic libraries. It further serves as a baseline for future studies since blockchain is in its early stages of development, and it is possible that it will continue to penetrate the market. The contribution is, therefore, descriptive in terms of perceptions of academic libraries on blockchain technology adoption factors and application examples, because of lack of knowledge of the participants. The blockchain revolution is not on the horizon, it is already here, and libraries should, therefore engage in this technology conversation to start the process of co-existence.

5.5. Limitations of the study

Lack of knowledge about blockchain technology which has been reflected in the study, impacted the return of the survey which took longer than the anticipated two months. As a result, the number of responses collected from the survey sample was very low. The respondents were assumed to have some degree of knowledge about blockchain technology and its potential applications in academic libraries. As a result, they were never screened for knowledge of blockchain. If they were screened before participation, they would provide insightful information about this technology to avoid deceptive results with incorrect responses. This, therefore, presents little rigorous evidence that can inform academic library professionals.

The researcher did not have direct access to the study participants, rather reached them through the designated contact person of their individual institutions to share the study participation invitations, which may have introduced bias.

The study only focused on eleven factors which influence the intention to adopt blockchain technology. R^2 value reflected in the model, presents weak accuracy (Wong, Tan, et al., 2020) as it can only explain 24% variance of the independent variables. This implies that for only 24% of variance in blockchain adoption intention was explained by endogenous variables. Therefore, a reader should exercise caution in interpreting the findings of this study because of low accuracy of the model (R^2 value), and the small sample size, which make generalisation of the findings to South African academic libraries difficult. Consequently, the TASC model is not efficient in explaining the influencing factors of intention to adopt emerging technology, such as blockchain, especially when the participants have insufficient knowledge of and experience with the new technology such as blockchain.

5.6. Suggested future research

Since little is known about blockchain implementations, especially in the academic library context, qualitative study through interviews and/or focus groups with experts and practitioners with thorough understanding of blockchain technology, and its potential applications, should be considered in future studies. This may incorporate specific beliefs of South African academic libraries' professionals into the model, which were not fully explored in this study. Furthermore, there are many other factors that may influence the adoption, which accounted for 76% of variance not accounted for by the predictor variables, should be considered for inclusion in the model for future studies to improve on the model accuracy (R^2 value). This presents an opportunity to conduct an in-depth longitudinal study that uses an inductive approach in a similar developing world context, to reveal new factors, hence a theoretical framework like TASC may not be used. In addition to the improvement on the validity and generalisation of the findings, it is recommended that sample size be increased. To advance the potential applications of blockchain suggested by this study, design science research may be applied to develop the software artefacts that can be evaluated for the proposed solutions in academic libraries as proofs of concept (PoCs).

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Appendix A: Survey Questionnaire

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Intention to adopt blockchain technology for collaborative business processes by academic libraries in South Africa

Section A-Demographic information

1. Age (years)

- Under 25
- 25-34
- 35-44
- 45 and above

2. Gender

- Male
- Female
- Prefer not to answer

3. Academic background

- ○ Bachelor's degree
- ○ Master's degree
- ○ PhD

Other (please specify)

[ ]

4. Speciality

- ○ LIS Professional
- ○ IT Professional

Other (please specify)

[ ]

5. Position occupied

- ○ Library Director
- ○ Head of Division

Other (please specify)

[ ]

6. Working experience in academic library (years)

○ Under 1	○ 11-15
○ 1-5	○ 16-20
○ 6-10	○ 21 and above

7. Employment status

- Permanent contract
- Renewable contract
- Fixed-term contract

Other (please specify)

8. Number of all library staff members

- Below 15
- 15-24
- 25-34
- 35-44
- 45-54
- 55 and above

9. Name of the university main library

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Intention to adopt blockchain technology for collaborative business processes by academic libraries in South Africa

Section B-7-Point Likert scale

10. Using blockchain technologies will enable the libraries to share metadata records easily.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

11. Using blockchain technologies will help libraries use one credentialing system to improve libraries' productivity.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

12. Using blockchain will improve customer services.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

13. Using blockchain will improve the relationships between the libraries.

Strongly disagree

Disagree

Somewhat disagree

Neither agree nor disagree

Somewhat agree

Agree

Strongly agree

14. Blockchain will require a lot of mental effort to use.

Strongly disagree

Disagree

Somewhat disagree

Neither agree nor disagree

Somewhat agree

Agree

Strongly agree

15. Blockchain use will be too complex for our library activities.

Strongly disagree

Disagree

Somewhat disagree

Neither agree nor disagree

Somewhat agree

Agree

Strongly agree

16. Skills needed to use blockchain technologies will be too complex for employees of the library.

Strongly disagree

Disagree

Somewhat disagree

Neither agree nor disagree

Somewhat agree

Agree

Strongly agree

17. Blockchain technologies will be compatible with the existing library systems used.

- Strongly disagree
- Disagree
- Somewhat disagree
- Somewhat agree
- Agree
- Strongly agree
- Neither agree nor disagree

18. Blockchain technology will be compatible with library business processes.

- Strongly disagree
- Disagree
- Somewhat disagree
- Somewhat agree
- Agree
- Strongly agree
- Neither agree nor disagree

19. Blockchain technology will be compatible with the current IT infrastructure.

- Strongly disagree
- Disagree
- Somewhat disagree
- Somewhat agree
- Agree
- Strongly agree
- Neither agree nor disagree

20. On blockchain technology, libraries and universities can connect to share any preferred kind of information to form Inter-Planetary File System (IPFS).

- Strongly disagree
- Disagree
- Somewhat disagree
- Somewhat agree
- Agree
- Strongly agree
- Neither agree nor disagree

21. The costs of adopting blockchain will be far greater than the expected benefits.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

22. The cost involved in maintaining blockchain system will be very high for our library.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

23. The cost involved in providing support systems for blockchain will be too high.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

24. The amount of money invested in training employees to use blockchain will be very high.

- Strongly disagree
- Disagree
- Somewhat disagree
- Somewhat agree
- Agree
- Strongly agree

Neither agree nor disagree

25. Top management will provide necessary support for blockchain technology adoption.

Strongly disagree

Disagree

Somewhat disagree

Somewhat agree

Agree

Strongly agree

Neither agree nor disagree

26. Top management will provide resources necessary for blockchain technology adoption.

Strongly disagree

Disagree

Somewhat disagree

Somewhat agree

Agree

Strongly agree

Neither agree nor disagree

27. Top management will support the use of blockchain technology.

Strongly disagree

Disagree

Somewhat disagree

Somewhat agree

Agree

Strongly agree

Neither agree nor disagree

28. Our library has the necessary resources to implement blockchain technologies.

Strongly disagree

Disagree

Somewhat agree

Agree

Somewhat disagree

Strongly agree

Neither agree nor disagree

29. Our library has employees who can learn the use of blockchain technologies easily.

Strongly disagree

Somewhat agree

Disagree

Agree

Somewhat disagree

Strongly agree

Neither agree nor disagree

30. There are employees who can provide new ideas on blockchain use for our library.

Strongly disagree

Somewhat agree

Disagree

Agree

Somewhat disagree

Strongly agree

Neither agree nor disagree

31. There is a specific person (or a group of employees) available to assist in case of blockchain-related difficulties.

Strongly disagree

Somewhat agree

Disagree

Agree

Somewhat disagree

Strongly agree

Neither agree nor disagree

32. There will be adequate technical support for blockchain provided by blockchain services providers.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

33. Blockchain technology service providers are encouraging our libraries to adopt blockchain by providing us with free training sessions.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

34. Training for blockchain technology will be adequately provided by service providers with support from the library consortia.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

35. Many of our customers will expect our library to adopt blockchain technology to eliminate duplication of efforts.

- Strongly disagree
- Somewhat agree

Disagree

Agree

Somewhat disagree

Strongly agree

Neither agree nor disagree

36. Our relationship with our customers will suffer if we do not adopt blockchain technology.

Strongly disagree

Somewhat agree

Disagree

Agree

Somewhat disagree

Strongly agree

Neither agree nor disagree

37. Our customers will consider us to be forward thinking by adopting blockchain technology.

Strongly disagree

Somewhat agree

Disagree

Agree

Somewhat disagree

Strongly agree

Neither agree nor disagree

38. Adherence to security standards and privacy relations will be a challenge with blockchain technology.

Strongly disagree

Somewhat agree

Disagree

Agree

Somewhat disagree

Strongly agree

Neither agree nor disagree

39. It will be harder to assess compliance of all personal data recorded on blockchain with the requirements of data protection law.

- Strongly disagree
- Disagree
- Somewhat disagree
- Somewhat agree
- Agree
- Strongly agree
- Neither agree nor disagree

40. With the use of blockchain, there will be a concern of legal implication to non-compliance to security standards and privacy regulations.

- Strongly disagree
- Disagree
- Somewhat disagree
- Somewhat agree
- Agree
- Strongly agree
- Neither agree nor disagree

41. I think we can trust academic libraries consortia members.

- Strongly disagree
- Disagree
- Somewhat disagree
- Somewhat agree
- Agree
- Strongly agree
- Neither agree nor disagree

42. We trust academic libraries consortia members to keep our best interest in mind.

- Strongly disagree
- Disagree
- Somewhat disagree
- Somewhat agree
- Agree
- Strongly agree
- Neither agree nor disagree

43. We trust our partnerships with other academic libraries will fulfil our obligations.

- Strongly disagree
- Disagree
- Somewhat disagree
- Somewhat agree
- Agree
- Strongly agree
- Neither agree nor disagree

44. Our library intends to adopt blockchain technologies in the near future.

- Strongly disagree
- Disagree
- Somewhat disagree
- Somewhat agree
- Agree
- Strongly agree
- Neither agree nor disagree

45. Our library intends to start using blockchain technology in the future.

- Strongly disagree
- Disagree
- Somewhat disagree
- Somewhat agree
- Agree
- Strongly agree
- Neither agree nor disagree

46. Our library will highly recommend blockchain technology for other libraries to adopt.

- Strongly disagree
- Disagree
- Somewhat disagree
- Somewhat agree
- Agree
- Strongly agree
- Neither agree nor disagree

Appendix B: Request for participation

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02 November 2019

Request to participate in a research study

Dear Participant,

In terms of the requirements for completing a Master of Commerce Degree in Information Systems at the University of Cape Town, a research study is required.

The researcher, **Lebohang Lengoatha**, has chosen to conduct a research study entitled: **Intention to adopt blockchain technology for collaborative business processes by academic libraries in South Africa. Blockchain technology** is the distributed database for storing transactional information, which is replicated and shared among members of the network to keep track of digital interactions among the participants. These transactions are irreversibly recorded in time-stamped blocks which are chronologically linked together through cryptographic mechanisms to form a chain of blocks.

The research has been approved by the Commerce Faculty Ethics in Research Committee, and your participation in this research is voluntary. All information will be treated in a confidential manner and used exclusively for the purpose of this study. No individual names will be recorded or published. You will not be requested to supply any identifiable information, ensuring anonymity of your responses. You can choose to withdraw from the research at any time for whatever reason, in accordance with the ethical research requirements.

The data collection method is a self-administered online questionnaire with the academic library managers (senior and middle), being the champions of the major initiatives happening in their libraries, and the librarians (including IT professionals working in the library), being directly involved in the successful execution of the library projects. The survey will last for approximately 10-20 minutes. If you are willing to participate in this study, kindly complete the survey to give consent to the researcher to use the data for the study.

Should you have any questions regarding this research, please feel free to contact me on the contact information provided below.

Your participation in this study would be greatly appreciated, but is entirely voluntary.

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Appendix C: Ethics Approval

Faculty of Commerce

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@Commerce UCT **UCT Commerce Faculty Office**

13th November 2019

Mr Lebohang Lengoatha
Department of Information Systems
University of Cape Town

Dear Mr Lengoatha

REF: REC 2019/10/065

INTENTION TO ADOPT BLOCKCHAIN TECHNOLOGY FOR COLLABORATIVE BUSINESS PROCESSES BY ACADEMIC LIBRARIES IN SOUTH AFRICA

We are pleased to inform you that your ethics application has been approved. Unless otherwise specified this ethical clearance is valid for 1 year and may be renewed upon application.

Please be aware that you need to notify the Ethics Committee immediately should any aspect of your study regarding the engagement with participants as approved in this application, change. This may include aspects such as changes to the research design, questionnaires, or choice of participants.

The ongoing ethical conduct throughout the duration of the study remains the responsibility of the principal investigator.

We wish you well for your research.

Shandre Swain
Administrative Assistant
University of Cape Town
Commerce Faculty Office
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Appendix D: Factor analysis

	1	2	3	4	5	6	7	8	9	10	11
Cronbach's Alpha	**PC (0.919)**	**RA (0.896)**	**CT (0.821)**	**TR (0.894)**	**IR (0.753)**	**IN (0.872)**	**MS (0.885)**	**CX (0.895)**	**SC (0.817)**	**CP (0.797)**	**IS (0.847)**
RA1		.913									
RA2		.909									
RA3		.852									
RA4		.614									
CX1								.611			
CX2								.945			
CX3								.963			
CT1			.854								
CT2			.844								
CT3			.843								
CT4			.679								

PC1	.879										
PC2	.835										
PC3	.850										
PC4	.753										
MS1							.880				
MS2							.805				
MS3							.656				
IR1					.540						
IR2					.752						
IR3					.799						
IR4					.825						
IS1											.776
IS3											.939
CP1										.817	
CP2										.854	

CP3										.771	
SC1									.829		
SC2									.867		
SC3									.811		
TR1				.856							
TR2				.882							
TR3				.829							
IN1						.859					
IN2						.891					
IN3						.776					

Extraction Method: Principal Component Analysis.

Rotation Method: Promax with Kaiser Normalization.

a. Rotation converged in 11 iterations.