FACTORS INFLUENCING THE ADOPTION OF BLOCKCHAIN TECHNOLOGY BY SOUTH AFRICAN COMMERCIAL BANKS

by

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FACTORS INFLUENCING THE ADOPTION OF BLOCKCHAIN TECHNOLOGY BY SOUTH AFRICAN COMMERCIAL BANKS

ABSTRACT

Blockchain technology became known as the technology that powers the cryptocurrency Bitcoin. Although this was blockchain's initial purpose, in recent years, it has proven capable of disrupting numerous industries. Innovation within the financial services industry has changed how the world and businesses operate. Many organisations, including global banking institutions, leverage blockchain technology to improve their organisations. However, blockchain adoption rates in developing countries, such as South Africa (SA), are relatively low. Motivated by the potential which blockchain technology possesses to disrupt the banking industry in a developing country, this study aims to understand the key factors of blockchain technology adoption by commercial banks in SA.

This study developed a categorisation framework to be used by Information Technology (IT) decision-makers and policymakers in banks in South Africa (SA) and other developing countries, to assist with strategy creation to accelerate blockchain adoption. The study employed an interpretivist qualitative research methodology to investigate the views of IT decision-makers and blockchain experts on the expected value and challenges hindering blockchain adoption in commercial banks of SA. Data was collected from IT decision-makers within commercial banks and blockchain experts within the South African context. Thematic analysis was used to analyse and understand the semi-structured interview responses of participants based on their backgrounds, knowledge of blockchain technology, and experience with IT adoption. The challenges and expected value for the adoption of blockchain technology by commercial banks in SA were investigated and technologically (T), organisationally (O), and environmentally (E) categorised using the TOE framework as a lens.

The study found that smart contracts, new banking services, and interbank collaboration are the expected value of blockchain adoption for SA commercial banks. It was further found that the expected value for blockchain adoption by SA commercial banks included lower costs, improved transactional speeds, provision for metaverse banking and

cryptocurrency investing, streamlined know-your-customer (KYC) processes, and finally improved payment settlements. The results also found that the technological challenge of blockchain adoption for SA commercial banks is blockchain complexity. Blockchain complexity was further found to be caused by scalability and interoperability challenges.

In addition to this, the study extended the TOE framework through a new challenge of trust within the interorganisational context. Trust encapsulated the issue of privacy and KYC documentation trust amongst commercial banks in SA. The categorisation framework can be used by IT decision-makers and policymakers in banks in SA and other developing countries to accelerate blockchain adoption.

Keywords: Blockchain, Blockchain Adoption, Distributed Ledger Technology, FinTech, Developing Countries

PART I – INTRODUCTION

1. INTRODUCTION

This chapter introduces the research by providing a detailed background on the topic of blockchain technology. It explains its origin and the importance of it in recent years. The purpose of the study will then be outlined, followed by the problem statement guiding this study. Thereafter, the research questions and sub-research questions will be identified. The research strategy will then be described and outlined. Next, the theoretical and practical significance for this study will be highlighted. Lastly, this chapter will identify the assumptions and limitations for this study, followed by a brief chapter overview of this research study.

1.1 BACKGROUND INFORMATION

The term blockchain became known as the technology that powers the cryptocurrency Bitcoin, ever since Nakamoto (2008) released a white paper on its invention as a response to the 2008 world financial crisis (Kawasmi et al., 2020). Although this was blockchain's initial purpose, in recent years it has proven to be capable of uses in various industries. Recent research suggests that blockchain technology is growing across multiple industries ranging from supply chain to manufacturing and retail. However, growth is seen most rapidly within the financial industry (Chang, Baudier, Zhang et al., 2020; Frizzo-Barker, Chow-White & Adams, 2020; Janssen, Weerakkody et al., 2019).

According to Rajnak and Puschmann (2020), although blockchain can be applied across industries, the attention of the public has been concerned with the financial industry due to blockchain's transacting properties. Omar et al. (2020) contend that as an emerging technology, blockchain makes provision for the creation of new digital services and platforms within the financial services sector. Moreover, Bitcoin has caught the attention of different people, organisations and industries in various regions around the world as the world's first widespread virtual currency. The cryptocurrency has forged the path to wider adoption and interest in distributed ledger and blockchain technology. According to Del Río (2017), many banks around the world are investigating ways in which blockchain technology can become integrated with their business models. This is because blockchain

can assist in areas of security, identity verification, data storage and anonymity (Liu, Farahani & Firouzi, 2021).

Many organisations including banking institutions make use of a traditional centralised ledger (Nair & Sebastian, 2017; Zutshi, Grilo & Nodehl, 2021). A centralised ledger entails a collection of all of the transactions recorded for the organisation and requires central authority where control is endowed to a single entity such as a bank or organisational firm (Nair, & Sebastian, 2017). This includes the traditional banking system, whereby all transactions are recorded on the system of the bank and can only be accessed by the transactors and individuals with high control within the bank. Contrastingly, with a distributed ledger – or decentralised ledger, there is no single central authority who has exclusive access to the transactions on the ledger (Perdana et al., 2021). This means that each transaction on the ledger can be accessed by anyone with an internet connection (Del Rio, 2017).

Moreover, built off the blockchain technology is the emergence of smart contracts. Smart contracts entail an array of executable code which is run on the blockchain which allows for the facilitation and enforcement of a set of agreed upon rules between 2 parties, without the need for a trusted third party (Alharby & Moorsel, 2017). Through the use of blockchain and smart contracts, the basic functions of borrowing and lending of cryptocurrencies can function in a decentralised manor (Kashyap, & Saurav, 2021). Financial technology (FinTech) companies across the world have leveraged blockchain technology and smart contracts, tapping into the service delivery chain of banks to provide clients better value proposition through their services. Some of these services include cross-border payments, peer-to-peer transactions, as well as borrowing and lending services at significantly lower rates than commercial banks (Chen & Bellavitis, 2020; Chang et al., 2020).

1.2 PROBLEM STATEMENT

Innovation is one of the crucial foundations to the continued success of commercial banks (Yoo, 2017). The disruption of technology is redefining the way in which banks conduct their business (Clohessy & Action, 2019). Moreover, banks are seen as lifelines in modern

society and function as fuel for the growth of developing countries (Nair & Sabastian, 2017). In correlation with this, SA is a third world developing country which had a poverty rate of 55.5% in 2020 (Climate Transparency Report, 2020). Large banks in developed countries, such as JP Morgan, have shown a strong interest in blockchain by developing and implementing a blockchain based solution to provide confidentiality of records concerning the financial sector (Sheth & Dattani, 2019). With new technologies such as blockchain emerging to be disruptive in the world of finance, South African banks are in a position to leverage this technology to help benefit and drive the future of their organisations. For instance, recent research conducted by Accenture (2019) estimates that the adoption of digital technologies such as real-time analytics, artificial intelligence and blockchain by the financial services industry in SA, can generate R1.2 trillion in value between the present and 2026.

According to a PWC report (PWC Global Blockchain Survey, 2018), a top trend in developing the market for traditional banks in SA is to address new advancing technology needs. They have found that financial technology (FinTech) firms are seen as a threat to traditional banks, as new entrants to the financial industry bring new types of innovation. This can be seen as a threat to traditional commercial banks who are slow to adopt new technologies. Furthermore, they have suggested that for traditional banks to remain relevant, they must accelerate potential transformational innovation. Blockchain technology has been recently adopted by various banking institutions around the world, however, the potential of fully adopting blockchain technology by commercial banks in developing countries creates the emergence of challenges.

Hassani et al. (2018) have researched how blockchain's big data effect will impact the financial industries' applications, specifically within the banking sector. They have suggested that research is still lacking, as blockchain industry use cases have only started to materialise, creating a gap for the adoption of blockchain technology within the financial sector. In addition to this, Toufaily et al. (2021) have recently explored the potential use of blockchain technology from a multi-organisation perspective, including industries from finance, supply chain, energy and real estate. According to Toufaily et al (2021), a technology is at its peak of the "inflated expectations" phase in Gartner's hype-cycle when there are expectations which surpass the current capabilities of a technology. This is the

point of the hype-cycle where researchers are advised to understand and investigate the potential use and challenges to the adoption of a technology (O'Leary, 2008).

Perdana et al. (2021) have explored future research avenues for blockchain technology with reference to Gartner's (2020) hype-cycle. They have suggested that other researchers should regularly explore the potential and challenges of blockchain adoption throughout the hype-cycle. In relation to this, Collomb and Sok (2016) suggest that due to the nature of blockchain's fast-paced changing environment, the assessment of its impact and effects on different industries should be on an ongoing basis. Research carried out by Ali et al. (2020) on the challenges and applications that DLT has developed within the finance sector, took on a more generic approach to the challenges and applications of DLT in the finance sector. These scholars have suggested further research of the challenges and applications of DLT, specifically within banking institutions.

Although the potential for blockchain technology in the banking sector looks promising, the adoption process is slow and developing countries are seen to be laggards in terms of adoption (Kshetri & Vosas, 2018; Underwood, 2016). According to Underwood (2016), blockchain has already benefited developing countries through financial inclusion such as the delivery of food assistance in the World Food Programme (WFP) for refugees in Syria. They state that blockchain is viewed as a disruptive technology with promising potential for various industries such as finance and real estate due to its unaltered, instantaneous access to data on the blockchain. They recommend that researchers explore the factors underpinning the adoption of blockchain within developing countries. Risius and Spohrer (2017) have encouraged the collection of primary data by researchers to obtain a better understanding of blockchain technology.

Hassani et al. (2018) mention that the financial industry, specifically within the banking sector, is steadily moving towards BCT and this is evident by the various BCT banking projects and partnerships that have been recently materialising. According to them, it is expected to alter the finance sector globally. The South African Reserve Bank (SARB) has initiated a blockchain based project known as 'Project Khoka' with the association of major commercial banks in SA (Consensus, 2020). Project Khoka aims to enhance interbank system processes through the use of blockchain technology. Major commercial banks in

SA are collaborating to create blockchain-based solutions to enhance the banking industry in SA.

Furthermore, these suggestions show that there is a clear motive for further research on blockchain technology adoption, specifically within the financial environment in developing countries. This research study is a step forward in research in terms of blockchain technology adoption by banking institutions within the SA context.

1.3 PURPOSE AND RESEARCH OBJECTIVES OF THE STUDY

This study aimed to investigate the key factors influencing the adoption of blockchain technology by SA commercial banks. The understanding of these factors was perceived through the perspectives of IT decision-makers in commercial banks and blockchain experts in the South African context.

To achieve the aim of this study, the following research objectives were identified:

- To explore the expected value for adopting blockchain technology in commercial banks in SA through the understanding of IT decision-makers and blockchain experts in the South African context.

- To understand the influential challenges of adopting blockchain technology by commercial banks as perceived by IT decision-makers in the SA context.

- To create a categorisation classifying the key factors for the adoption of blockchain technology by SA commercial banks.

By understanding the key factors influencing the adoption of blockchain technology by SA commercial banks, IT decision-makers and policymakers will be able to create strategies to help combat blockchain adoption challenges. Additionally, it provides IT decision-makers with the value which blockchain technology renders for the SA commercial banking industry, accelerating the adoption rate of blockchain within banking organisations in SA.

1.4 RESEARCH QUESTIONS

To investigate the key factors influencing the adoption of blockchain technology by SA commercial banks, the following main and sub-research questions were formulated:

Main Research Question (MRQ):

MRQ: What are the influential factors for the adoption of blockchain technology by commercial banking institutions in SA as perceived by IT decision-makers and blockchain experts in SA?

Sub-Research Questions (SRQ):

The following sub-research questions will assist in the discovery of information that will answer the main research question:

SRQ1: What is the expected value for the adoption of blockchain technology by commercial banks in SA, as perceived by SA banking professionals and blockchain experts?

SRQ2: What are the influential challenges hindering the adoption of blockchain technology by commercial banks in SA as perceived by SA banking professionals?

SRQ3: What would a framework categorising the expected value and influential challenges of blockchain adoption in SA commercial banks look like?

By considering these questions, the key factors for blockchain adoption by SA commercial banks could be identified.

1.5 RESEARCH STRATEGY

The study employed an interpretivist philosophy with a survey strategy. Data collection entailed semi-structured interviews which involved IT decision-makers employed within commercial banks and blockchain experts in the SA context. The reason for choosing these 2 participant groups was to gain insight and understanding on the topic of blockchain adoption in the SA banking industry from an internal and external viewpoint. The internal viewpoint encompasses the views of the IT decision-makers employed within SA

commercial banks, whereas the external viewpoint encompasses the views of blockchain experts from SA. Additionally, the views of IT decision-makers assisted in understanding the expected value and challenges of blockchain adoption within the SA banking industry, whereas the views of blockchain experts assisted in understanding only the expected value of blockchain adoption in the SA banking industry.

Qualitative semi-structured interviews were utilised to collect data from a selected number of research participants. The sample size selected for this study was 9, of whom 5 were IT decision-makers and 4 were blockchain experts. According to Hennink and Keiser (2022), interviews of 9 to 17 and focus groups of 4 to 8 are appropriate for qualitative studies to reach saturation. Additionally, Onwuegbuzie (2007) states that a smaller sample size in qualitative research is appropriate when participants possess expert knowledge in a particular field of knowledge. IT decision-makers encompassed a larger sample size than blockchain experts. The reason for this is because decision-makers can provide rich information on blockchain adoption challenges and expected value, whereas blockchain experts can provide rich information solely on the expected value of adoption for banks in SA. The sample size of 9 was appropriate for this study because blockchain experts possess expert knowledge on the topic of blockchain and IT decision-makers possess expert knowledge on the topic of technology adoption. The analysis of the qualitative data gathered from the 9 interviews revealed a consistent presence of recurring themes and perspectives, indicating that data saturation has been achieved with the limited sample size. In addition to this, documents and secondary data were used to supplement the semi-structured interviews with confirmation of findings. These documents and secondary data included white papers, banking institution reports and project plans.

Qualitative data analysis was conducted to understand, interpret and explain the responses of the research participants. The study utilised a thematic analysis to analyse and interpret the data collected from the research participants. The study used an inductive research approach to help answer the research questions by deriving insights from the feedback of participants. This approach was flexible and allowed the researcher to address new ideas that emerged during the data collection process. The two datasets were integrated through posing 3 of the same questions to determine the views from each participant group. One of the participant groups was posed additional questions because

they possessed more specific knowledge on blockchain technology adoption within the SA banking industry.

1.6 ASSUMPTIONS

The underlying assumption of this research study is that all participants answered the questions honestly to their best understanding of blockchain technology and technology adoption.

1.7 STUDY SIGNIFICANCE AND CONTRIBUTION

1.7.1 Theoretical

This research study contributes to the body of knowledge in blockchain technology and blockchain technology adoption. It adds knowledge to the challenges and expected value of blockchain technology from a developing country's perspective. Furthermore, this research uncovers specific challenges and expected value for adopting blockchain within the SA banking industry.

Moreover, this dissertation benefits researchers in formulating a hypothesis for future research regarding the technological, organisational and environmental impacts which influence the adoption of blockchain technology in the banking industry. Additionally, the categorisation framework provides a list of the factors upon which researchers should focus, should they wish to better understand and gain insight into blockchain adoption in general and specifically within the banking industry in developing countries.

1.7.2 Practical

This study provides a practical contribution through a categorisation framework for decision-makers and policymakers within banking institutions in SA and other developing countries to use as a guide in developing policies and strategies to help speed up the adoption of blockchain and generate value for the organisation.

Moreover, to accelerate the adoption process by banking institutions, changes will be required at the technological level (e.g., the development of solutions to overcome such challenges), the organisational level (e.g, the refinement of business processes to assist with the implementation of adoption) and the environmental level (e.g, government and

regulation considerations). Furthermore, the categorising framework also assists by outlining the expected value that banking institutions in SA and other developing countries can expect for the adoption of blockchain technology, from the views of banking professionals and blockchain experts.

1.8 LIMITATIONS

The study was limited to only the South African context as a developing country. The study was also limited to a total of 9 research participants because many prospective participants were unable to disclose organisational information regarding the topic of blockchain technology due to confidentiality restrictions. Finally, the study was also limited specifically to commercial banking institutions.

1.9 BRIEF CHAPTER OVERVIEW

Figure 1 displays the chapter overview of this research study. It includes a brief explanation of Chapter 1 to Chapter 6.

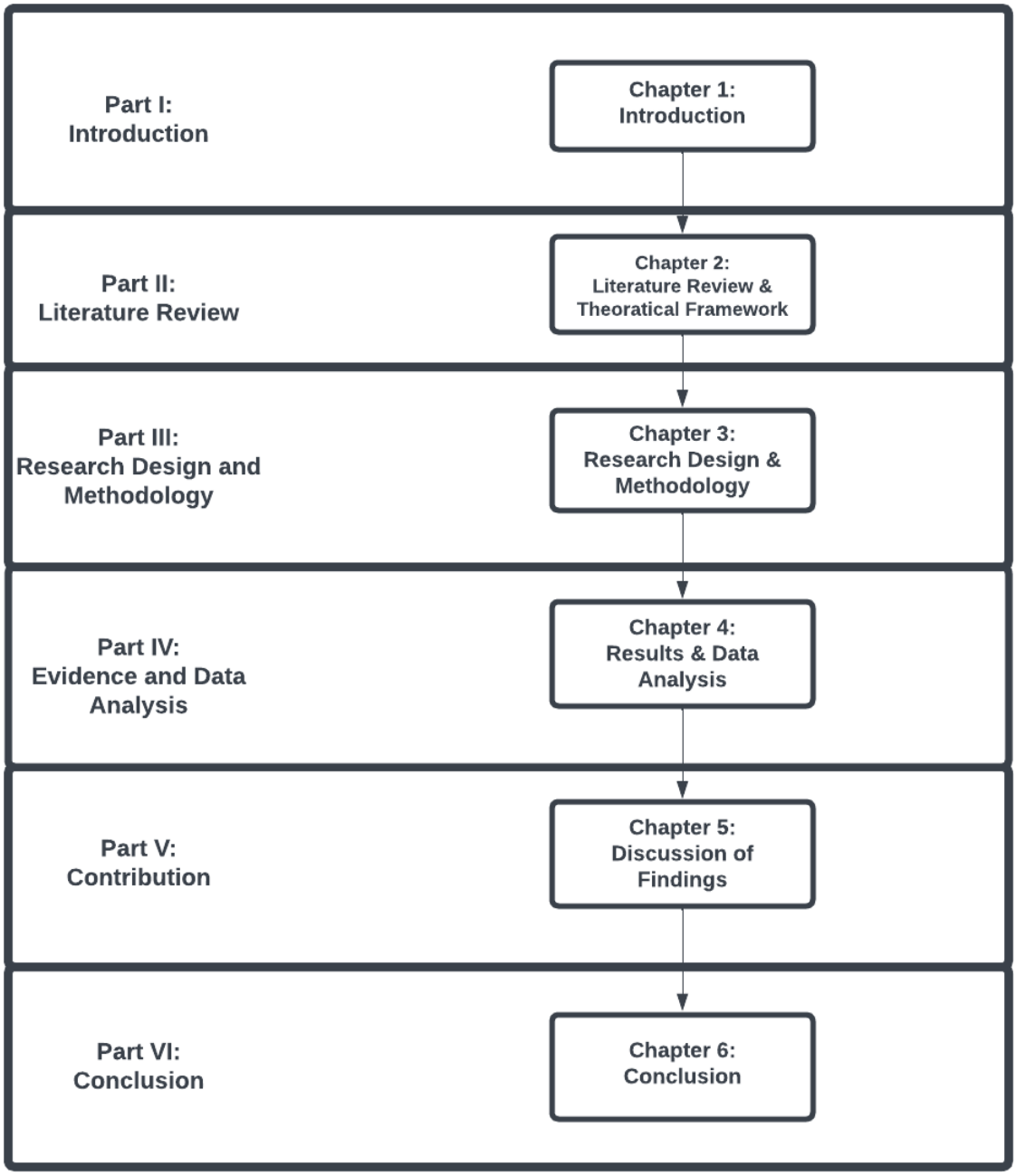

Figure 1: Chapter Overview

Chapter 1: Research Introduction

This chapter provides the details of the problem to be investigated and the reasons for investigation. The sub-headings for this chapter include the introduction, the background information, the purpose and research objectives for the study, the problem statement, the

research questions, the assumptions, the theoretical and practical significance and the limitations.

Chapter 2: Literature Review and Theoretical Framework

This chapter presents detailed information on the existing academic literature relating to the problem being investigated. It encompasses literature based on blockchain as a technology in terms of its characteristics, types and stages in relation to the banking industry and finally an understanding of blockchain within the banking industry. It further details the current adoption motivators and challenges for blockchain in the financial and banking industry. The theoretical TOE framework is then introduced and discussed. The technological, organisational and environmental considerations for blockchain adoption in organisations are outlined to help guide the study. This chapter concludes with the development of a categorisation framework utilising TOE as a guideline.

Chapter 3: Research Methodology

In the first section of this chapter the researcher describes the research method selected for this study. The chapter entails the underlying philosophical assumptions for this study, the research approach, the appropriate research strategy, the research choice and the time horizon selected. The next section discusses the sampling approach in terms of the target population, sampling method and the sample size. The last section of the chapter will detail the selected data collection and data analysis methods.

Chapter 4: Results and Data Analysis

This chapter outlines the key factors of blockchain technology adoption by SA commercial banks from the 9 interviews conducted. An introduction to each participant is first presented. Next, the participant responses for each interview question are presented through the structure of the interview guide. The challenges and expected value for blockchain technology adoption by SA banks are outlined through the views of blockchain experts and IT decision-makers in SA banks.

Chapter 5: Discussion

Chapter 5 discusses the findings stemming from Chapter 3. This chapter answers each of the research questions of Chapter 1. It further compares and contrasts the results of the study with each other, the literature review in Chapter 2 and the secondary data obtained.

It is envisioned that the insights gained from the discussion in this chapter would increase blockchain adoption awareness that will guide the design of future blockchain adoption processes in the SA banking industry, ultimately accelerating the rate of blockchain adoption. This chapter also presents a categorisation framework for blockchain adoption in the SA banking industry to be used by policymakers and IT decision-makers to assist in accelerating blockchain adoption.

Chapter 6: Conclusion

Chapter 6 concludes the study by firstly providing an overview of the study and the research questions and objectives. The next sections provide a summary of findings of the study, the study contribution in terms of the theoretical and practical considerations, the research limitations and finally avenues of recommendations for future researchers.

PART II – LITERATURE REVIEW

Part II consists of Chapter 2 and entails the literature review and theoretical framework selected for the study. Figure 2 depicts the progress of the study.

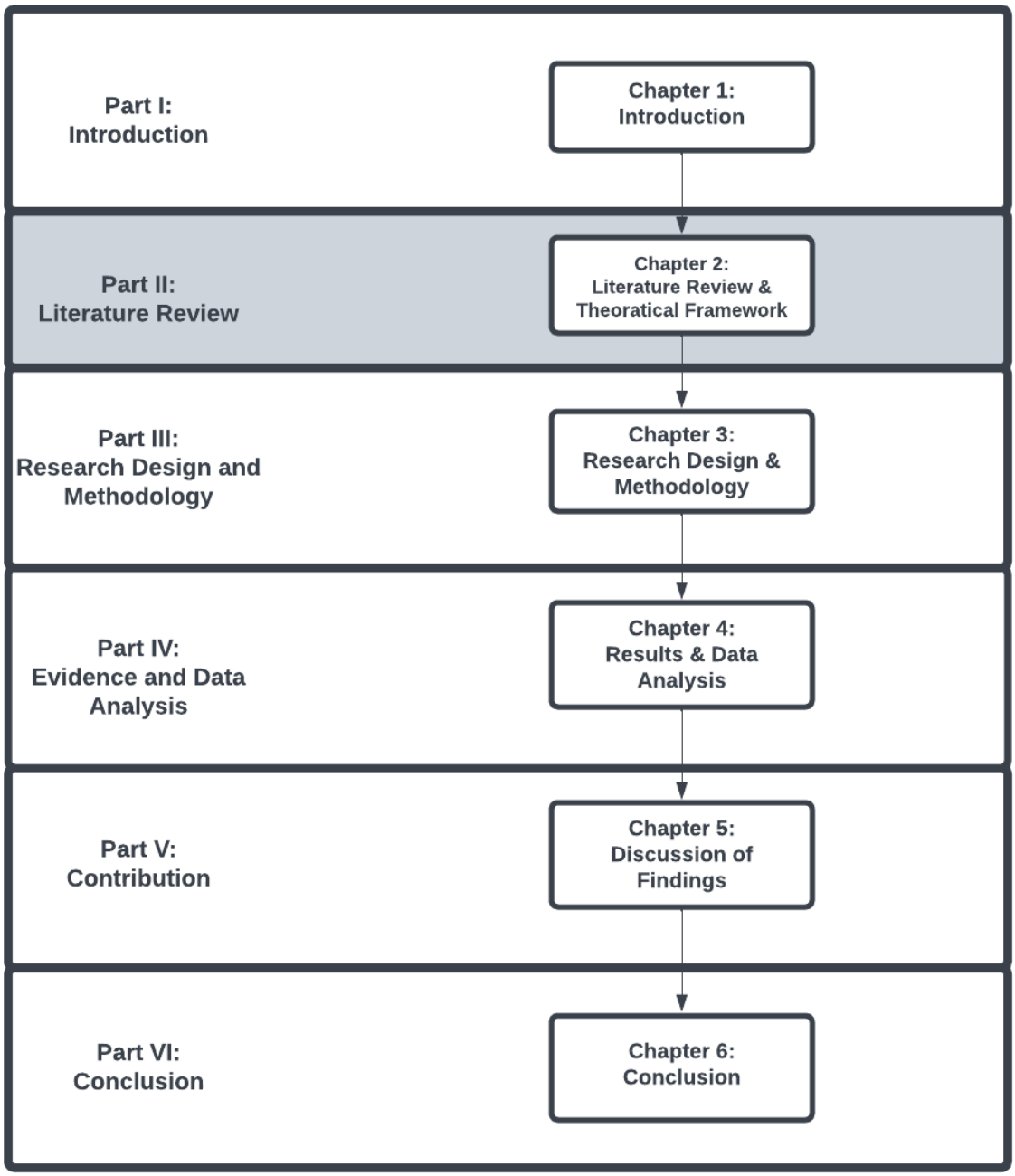

Figure 2: Part II – Literature Review

2 LITERATURE REVIEW

2.1 INTRODUCTION

This chapter reports on the literature on blockchain technology, blockchain technology adoption, relevant adoption benefits and challenges for blockchain in banking institutions, and the TOE framework which applies to this research. A general understanding of blockchain technology and how it works is required for this study.

The first section explains what blockchain is in terms of its mechanism. The different types of blockchain are discussed next, followed by appropriate factors which characterise blockchain. Thereafter the section reports on the different blockchain maturity stages. The following section reports on the adoption of blockchain technology in banks and financial institutions, the challenges identified for blockchain adoption and the benefits of blockchain adoption. Within this section, the challenges and benefits of blockchain adoption from a general and SA viewpoint are identified through secondary data, such as white papers and official SA banking institution reports. The final section of this chapter will introduce the theoretical framework that will guide this study. The TOE framework will be discussed, and relevant factors drawn from literature will be identified and explained.

2.2 BLOCKCHAIN TECHNOLOGY

A blockchain is a “distributed database” of a continuously growing register of data records constituting transactions that prohibit tampering and amendment of the chains’ records (Yoo, 2017). Members on a blockchain network mutually record, verify and store information on transactions to ensure the reliability of the transaction records, without the use of a trusted third party (Zheng et al., 2017). The security of blockchain is further preserved as it ensures that all of the members’ ledgers are constantly updated as a transaction occurs. For a transaction on the blockchain to be approved, it is required to be verified by each participant on the blockchain network of the specific transaction. This adds to the security and “tamper-proof” nature of a blockchain.

Blockchain technology is used interchangeably with the term distributed ledger technology (DLT). A blockchain is a distributed ledger which allows a recording of transactions consisting of uniquely identified hash values within a network (Staples et al., 2017). A hash function is used to map data of arbitrary size to data of fixed size and its main properties

entail uniqueness and irreversibility. Figure 3 depicts the process of how a blockchain is built through its hash sequence. Recorded transactions are contained within a block which contains a timestamp and hash value of the recorded transactions. Each block on the blockchain is a representation of the present transaction and contains information of the previous and preceding transactions. Furthermore, each time a new transaction occurs, a new block is linked to the previous block by referring to its hash value, creating a chain of blocks. Each hash code is automatically generated on the network. This means that it is not possible for the hash information to be tampered with. The preceding block's hash code strengthens the verification of the previous block, emphasising the 'tamper-proof' nature of a blockchain. Finally, new blocks added to the chain increase the safety and reliability of the blockchain (Golosova & Romanovs, 2018).

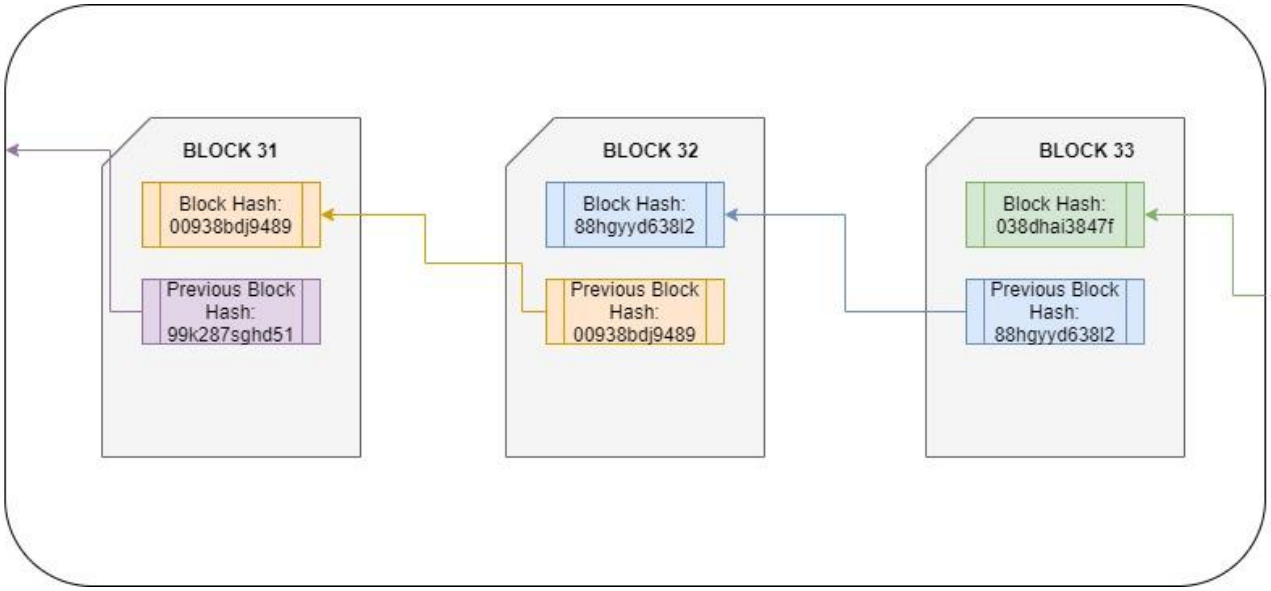

Figure 3: The Hash Value Sequence in a Blockchain (Researcher)

2.2.1 Types of Blockchains

There are 3 main types of blockchain, namely private, public and consortium blockchains (Xu et al., 2017). Private and public blockchains, also known to be 'permissioned' and 'permissionless' respectively are explained below:

2.2.1.1 Private or Permissioned Blockchains

This type of blockchain allows access to the network for selected and specific participants to the chain on the network. Authorisation is required by a high level of authority for any user who wishes to publish blocks on the network (Yaga et al., 2018). As a result of controlled access to the blockchain, the restriction of read access and determination of who can issue transactions is possible only by the ruling of the centralised authority. Write access on the network is given by the authorised party or organisation, however within a private blockchain, read permission over the network can be public or permissioned. A more flexible approach towards maintaining and instantiating a private or permissioned blockchain can be achieved through open and closed source software (Zheng et al., 2017). As a result of its flexibility, private blockchains are commonly hosted by single organisations (Xu et al., 2017). A permissioned blockchain allows for the rules of the ledger to be changed at the organisation's discretion. To further protect the interests of all participants on a permissioned blockchain, legal contracts and agreements are made off the chain with participants on the network. These contracts and agreements act as an incentive for honest behaviour amongst participants, through the threat of possible legal proceedings in the event of a transgression of the contract or agreement.

2.2.1.2 Public or Permissionless Blockchains

In a permissionless or public blockchain, there are no restrictions to read or add new blocks on the network (Golosova & Romanovs, 2018). This means that anyone may have access to the chain on the network, as it is collectively owned and run by all participants on the network. As a result, these type of blockchains are known to be decentralised (Zheng et al., 2017). Public blockchains therefore have no centralised authority or a trusted third party, as with private blockchains. In this 'permissionless' blockchain, members on the network do not know each other. Trust is therefore created through the reward of a 'native token' for each participant running nodes on the network.

2.2.1.3 Consortium Blockchain

A consortium blockchain is partially decentralised as it allows for certain elements on the chain to be public, while others are private (Beck et al., 2017). This type of blockchain can either be private or a hybrid of private and public, as it still requires permission to access it (Dashkevich, 2020). It is therefore a common selection for blockchain usage amongst organisations (Deshpande et al., 2018). In addition to this, the restricted number of

participants on the blockchain network, as well as the requirement of permission to access the network, ensures that the data on the network is kept secure and confidential. A consortium blockchain therefore allows for better management of data on the network amongst permissioned participants.

2.2.2 Key Characteristics of Blockchain Technology

From a general view, blockchain can be characterised by the characteristics of auditability, anonymity, decentralisation, immutability and transparency. Each of these characteristics is described below:

2.2.2.1 Auditability

Each transaction recorded on a blockchain is chronologically ordered. This means that each transaction is connected to each other one, with the relevant information it contains inside a hash (Zheng & Xie, 2018). A block's previous hash is stored along with the current transaction's hash which then connects the next block once added. This mechanism enables verification and allows for the block containing the hash information to be traced at any point.

2.2.2.2 Anonymity

Participants on the blockchain network can interact with each other through the generation of a unique address. Users who wish not to expose their identities can generate multiple addresses (Zheng et al., 2018). The identities of users are also protected, because in a typical blockchain (such as permissionless), there is no central authority or party holding the user's private information, as within a centralised banking institution. The use of this mechanism ensures that certain aspects of a transaction's privacy is preserved on the blockchain.

2.2.2.3 Decentralisation

In a centralised transaction system, verification of each transaction is required by a trusted agent of the centralised party (e.g., central banks). Applications of blockchain technology are characterised as decentralised because they do not require a centralised party in order to transact (Peters & Panayi, 2016). The first decentralised blockchain use, Bitcoin, has created the emergence of decentralised applications and platforms through the use of blockchain (Semenova, 2020).

2.2.2.4 Immutability

Blockchains are viewed as immutable because data cannot be secretly altered once it has been recorded on the ledger without ensuring that each participant on the network knows, guaranteeing that data is 'tamper-resistant' (Tasca & Tessone, 2018). The immutability of a blockchain is maintained due to the use of hashes and blocks on the network.

2.2.2.5 Distributed

Blockchains are distributed in nature, meaning that all blockchain network participants possess a copy of the ledger, ensuring complete transparency (Saheb & Mamaghani, 2021). The distributed ledger ensures that every node on the network maintains the ledger and participates in validation. Participants on the blockchain network also distribute computational power amongst each other, ensuring a better outcome for the network (Zutshi et al., 2021).

2.2.2.6 Transparency

Blockchains are transparent through visibility of records on a blockchain network (Yaga et al., 2018). There are various levels of transparency depending on the type of blockchain being used (Zutshi et al., 2021). For instance, public blockchain records are publicly available and transparent for anyone to view, whereas private and consortium blockchains are only transparent to participating members of the network.

2.2.3 Stages of Blockchain Maturity

BCT has progressed incrementally since the concept of Bitcoin proposed by Satoshi Nakamoto was introduced in 2008, which described how the combination of an open distributed ledger and cryptology can be used to create a digital currency application. The technology was initially not programmable, which means that functionality and scope of use were limited to a store of value, such as Bitcoin. However, blockchain has in recent years emerged to integrate programmable functionality within its scope of utility. According to Angelis and Ribeiro da Silva (2019), a programmable blockchain increases the scope for market decentralisation usage of blockchain in a general context. Moreover, there are different stages of blockchain through such evolutions. Figure 4 illustrates the three evolutions constituting blockchain technology. The following section explains each stage.

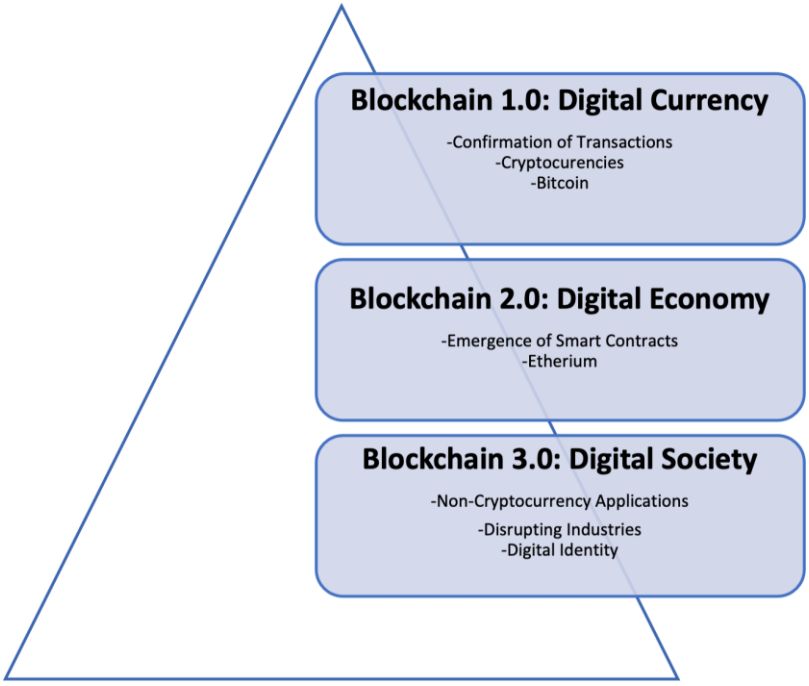

Figure 4: Blockchain Evolution (Researcher)

2.2.3.1 Blockchain 1.0

The first era of blockchain applications is underpinned by the confirmation of transactions on a decentralised ledger system. Its focus observed applications which are cash based such as currency transfer, digital payment systems and remittance (Swan, 2015). Bitcoin is a common example for Blockchain 1.0. Bitcoin is the first decentralised digital currency which encompasses encryption techniques to make provision for peer-to-peer transactions in a system. Bitcoin works without the need of a central bank or an administrator facilitating the transaction. During the era of Blockchain 1.0, the use of blockchain technology focused on transfers, payments and transactions of digital currencies.

2.2.3.2 Blockchain 2.0

The second era of blockchain encompasses the exchange of transactions as in Blockchain 1.0 and extends it for developers to build programmes and APIs on the blockchain network (Kehrli, 2016). It constitutes a wide range of financial and economic applications which function beyond transactions, payments and transfers (Efanov & Roschin, 2018). These programmes and applications are built in the form of smart contracts. Smart contracts are computable agreements containing executable logic. The use of smart contracts enables autonomous operations due to its pre-defined executable set of rules. In addition to the executable set of rules, smart contracts can hold digital currencies and manage the control

of digital assets which are recorded on the blockchain (Staples & Falamak, 2017). These agreements are digitally signed by the parties involved and are shared on the blockchain network.

Ethereum is the first platform to run smart contracts and has allowed the emergence of various use cases for blockchain such as support mortgage lending, loans and crowdfunding, which are underpinned by cryptocurrencies (Berdik et al., 2021). Ethereum users participating in these services may earn interest in the form of Ether for providing liquidity to blockchain related financial platforms, such as AAVE and Compound. Ether is the cryptocurrency underpinning Ethereum and works as a reward for developers and stakeholders. The emergence of smart contracts has expanded the scope for the use of blockchain technology amongst various industries including finance (Christidis & Devestsikiotis, 2016).

2.2.3.3 Blockchain 3.0

The third era of blockchain constitutes applications past the scope of Blockchain 1.0 and Blockchain 2.0. It refers to a wider spectrum of non-cryptocurrency applications uses and aims to impact various industries (Di Francesco Maessa & Mori, 2020). The focus of this stage refers to applications encompassing non-fungible tokens (NFTS), health science, identity, education, governance and education (Efanov & Roschin, 2018; Hughes et al., 2019; Sheth & Dattani, 2019). An example of Blockchain 3.0 includes non-fungible tokens (NFT). NFTs are blockchain-based tokens which extend their functionality by ensuring that each token is unique and undividable (Regner & Schwizer, 2019). Fungible tokens, such as cryptocurrencies, differ from NFTs because they are divisible and not distinguishable. NFTS make provision for the representation of individual assets through tokenising the asset on the blockchain (Zutshi et al., 2021). An example of an NFT in the space of the banking environment, is client KYC documents which are stored on the blockchain.

Noted use cases within Blockchain 3.0 include identity management, electronic voting and smart cities (Larios-Hernandez, 2017; Efanov & Roschin, 2018). An increasingly growing interest within Blockchain 3.0 includes digital identity. Digital identify using NFTs can provide financial inclusion to the unbanked globally and within developing countries (Kashyap & Saurav, 2021; Efanov & Roschin, 2018).

2.3 BLOCKCHAIN IN THE BANKING INDUSTRY

The banking industry is facing numerous challenges related to outdated infrastructure, increasing competition, and growing regulatory scrutiny (Bhattacharya, 2021). In response, financial institutions are exploring innovative solutions such as blockchain technology to improve their operations, enhance customer experience, and gain a competitive edge. Blockchain technology offers several benefits to the banking industry, including increased efficiency, reduced costs, enhanced security and greater transparency (Deloitte, 2020). Blockchain-based solutions such as smart contracts, digital identity management and cross-border payments have the potential to transform the banking industry by streamlining processes, reducing fraud and improving data privacy (Swan, 2015).

Several major financial institutions have already implemented blockchain-based solutions to improve their operations. JP Morgan Chase, for instance, has developed its own blockchain platform, Quorum, for processing financial transactions, while the Bank of America has filed numerous patents related to blockchain technology (Bhattacharya, 2021). Other banks, such as Barclays and Wells Fargo, have collaborated with blockchain startups to explore the potential of this technology in areas such as trade finance and supply chain management (Deloitte, 2020). Despite the challenges related to regulatory compliance, interoperability and scalability, blockchain technology is expected to play an increasingly important role in the banking industry in the coming years (Bhattacharya, 2021).

Blockchain technology has the potential to disrupt the traditional banking industry by changing the way in which financial services are delivered and consumed. With the use of blockchain technology, banks can move from a centralised model to a decentralised model, eliminating intermediaries and reducing transaction fees (Hou, Ma & Wang, 2020). This shift can help to increase financial inclusion by providing access to financial services to underbanked and unbanked populations worldwide (Gómez-Puig & Sosvilla-Rivero, 2021). Moreover, blockchain-based systems can enable faster settlement times, improved security and increased transparency, which can ultimately lead to a more efficient and trustworthy financial system (Swan, 2015). However, for blockchain technology to be fully embraced by the banking industry, regulatory frameworks need to be developed to address concerns such as data privacy, security and fraud prevention (Böhme, Christin, Edelman & Moore, 2015).

2.4 BLOCKCHAIN ADOPTION MOTIVATORS IN THE BANKING INDUSTRY

This section of the literature review identifies the motivators of adopting blockchain technology in the general banking industry and specifically within the SA banking industry in accordance with official white papers, SA banking institution reports and existing journal articles pertaining to blockchain technology. These motivators include smart contracts, improved transaction speed, KYC improvement and cost reduction.

2.3.1 Smart Contracts

The development of contracts is time consuming, involving intricate processes in the banking and financial world (Peters & Panayi, 2016). Smart contracts can be created through blockchain platforms such as Ethereum to authorise financial transactions once parties within the smart contract either meet a certain criterion or perform a certain task (Kawasmi et al., 2020).

Within the banking sector, the Commonwealth Bank of Australia have used smart contracts for monitoring and tracking shipments of large weights of almonds (Mittal, 2018). Banks can also make use of smart contracts for clearing and settlement of payments. A consortium of over 40 global banks called R3 has been formed to test the clearing and settlement properties through the use of smart contracts (Hu et al., 2018).

Within the SA banking industry, the South African Reserve Bank (SARB) has initiated Project Khoka, with the intention to explore the use of interbank payment settlement using smart contracts built on the Ethereum platform (Consensys, 2020). Project Khoka achieved 70,000 transactions which were executed in less than 2 hours (SARB, 2018). According to Consensys (2020), these transactions have reduced a full business days' worth of processing time by 75%. The project created a stable coin for the South African Rand (ZAR). The tokenised ZAR created a domestic payment system which enabled the participating banks to transact, redeem and track each transaction on the blockchain without a centralised banking system (SARB, 2018).

2.3.2 Improved Transaction Speed

Blockchain technology can be utilised to enable banking institutions to increase the speed of their transactions and settlements. According to Hassani et al. (2018), blockchain allows corporations and individuals to transact directly and observe the same ledger constituting

the transactional updates in real time. This allows for faster settlement times amongst banks. Tapscott and Tapscott (2016) note that blockchain can reduce settlement times to minutes or seconds, whereas traditional settlement times amongst banks may take days. In addition to this, Cocco et al. (2017) state that blockchain technology can provide the possibility for banks to process transactions at a 24/7 rate, improving the transactional availability internally for banking institutions, as well as for the clients of banks. In accordance with this, according to a blockchain report by Standard Bank (the African Blockchain Report, 2021), blockchain technology will improve settlement times of payments by a minimum of twice the current settlement time.

2.3.3 KYC Process Improvement

The verification of customers' authenticity is identified as a salient task for banks relating to regulatory anti-money laundering concerns (Sarnitz & Maier, 2017; Hassani et al., 2018). To prevent identity theft and terrorist financing, each bank has the requirement of doing their due diligence on their clients (Thavanathan, 2017). This process is encompassed by the "Know Your Customer" regulation. KYC provides auditable evidence in terms of a client's identity, suspicious activities, client identification and record keeping.

Blockchain can enable banks to share customer data in a secure manner across their company. This is done by reducing duplicate requests or information, thus simplifying the administration process. Blockchain can verify a specific client's information once and the client's information will be sealed on the network, allowing for other banks to have access to it. The privacy of the client's information can also be secured through the use of a consortium or private blockchain. The standardised sharing of client account information through the use of blockchain creates a KYC record which is "tamper-proof", highlighting the bank's compliance with regulation (Hassani et al., 2018; Thavanathan, 2017). The KYC process will increase the interoperability amongst commercial banks, because the information can be easily accessible on the network, reducing the duplication of data and administrative costs amongst banks.

2.3.4 Cost Reduction

Blockchain technology enhances trust through its properties of transparency and immutability. Beck (2018) and Hassani et al. (2018) argue that blockchain technology's transparent nature can reduce friction comprising of direct and indirect costs which emerge due to lack of trust. Hassani et al. (2018) state that blockchain will bring certainty through the logic of transactions which is instantiated as code. In addition to this, Accenture (2020) found that blockchain technology could reduce the costs of clearing and settling by $10 billion annually.

2.5 CHALLENGES OF BLOCKCHAIN ADOPTION IN THE BANKING INDUSTRY

This section examines the challenges of blockchain technology adoption within the general banking industry, and specifically within the SA banking industry. The challenges identified within the SA banking industry were understood through secondary data of white papers, SA banking institution reports and existing journal articles pertaining to blockchain technology. These challenges included volatility of currency, lack of legislation, scalability and high energy consumption.

2.4.1 Volatility of Currency

Hassani et al. (2018) believe that most banks are opposed to the use of Bitcoin as a currency for transactions. For the adoption of blockchain payments, there is a high dependability on the stability of the cryptocurrency or token by which it is underlined. The stability of the underlying cryptocurrency is seen to be highly volatile based on the changing cryptocurrency market. Hassani et al. (2018) have suggested the use of a "stable coin" for the use of blockchain payments by banks. A stable coin is a recently developed cryptocurrency which has a low-price volatility, because the value it possesses is secured by a fiat currency such as the US dollar and the South African Rand (Kawasmi et al., 2020).

2.4.2 Lack of Legislation

Toufaily et al. (2018) have found that the lack of legislation for both public and private blockchains is a hinderance to its adoption from a general perspective. Blockchain technology makes provision for cross-border payments through the use of

cryptocurrencies (Yoo, 2017). This means that any user on the network may send cryptocurrencies internationally, without any standardised regulation. Toufaily et al. (2018) found in their study that due to blockchain's cross-border nature, there is a need for international regulatory principles amongst regulators. In addition to this, Kawasmi et al. (2020) also highlighted the concern that uncertain regulatory principles of cryptocurrencies can delay the adoption of blockchain throughout the banking sector.

2.4.3 Scalability

According to Zheng et al. (2017), the size of a blockchain will continuously grow over time due to the incremental number of daily transactions added to the blockchain. They also argue that the size of the block and the expectation for time intervals would not allow for extremely high volumes of transactions to be processed in real time. Kawasmi et al. (2020) also state that some central banks find blockchain technology unsuitable for the infrastructure of current payments. This is also due to the high volumes of anticipated transactions and its scalability issue.

Hassani et al. (2018) found that the large volumes of transactions occurring on the blockchain can contribute to the size of big data in banking. They suggest that blockchain will therefore require sound and reliable hardware and software to ensure that the big data is well handled. In addition to this, Marjin et al. (2020) state that the degree for the challenge of scalability will differ depending on its application. For instance, for high volume products scalability can be seen as a big challenge, whereas for low market segments such as for security of a bank loan, it will be less of challenge.

2.4.4 High energy consumption

Blockchain technology has recently been critiqued for its high consumption of energy. According to Clohessy and Action (2019) and Hassani et al. (2018), the encryption feature for blockchain, which is used to initiate consensus amongst participants on the blockchain network, determines whether a user has permission on the network through the completion of complex algorithms. These complex algorithms are run on computers and therefore require high amounts of computational power. This requirement creates high energy consumption and as the transactions increase, more algorithms are required resulting in more energy being consumed.

Kawasmi et al. (2020) state that the consumption of energy in organisations, however, is much less than compared to that of a public blockchain, such as Bitcoin. For the banking industry, appropriate blockchains may be suited for single organisations or inter-organisational ones such as inter-bank payment clearing and KYC relative blockchains (Kulkarni & Patil, 2020; Chang et al., 2020). The energy consumption of these blockchain examples is relatively low compared to public blockchain energy usage, however, the energy consumption concern should not be ignored. Kulkarni and Patil (2020) state that large energy usage is expected, however, to be objective, the energy usage should be benchmarked against the current system's energy consumption.

2.6 THEORETICAL FRAMEWORK

This section of the literature review explains the selected framework that is used as a lens to help categorise the factors, challenges and benefits that influence the adoption of blockchain technology by commercial banks in SA.

Many information system (IS) models have been previously used to successfully understand various factors influencing blockchain technology in various industries. Yusof et al. (2018) used the Unified Theory of Acceptance and Use of Technology (UTAUT) to study blockchain adoption within the Malaysian banking industry. Heidari et al. (2019) used the Diffusion Innovation Theory (DOI) to study the adoption of blockchain technology within the financial market of Iran. Saheb and Mamaghani (2021) utilised the Technology-Organisation-Environment (TOE) framework to determine the factors influencing the adoption of blockchain technology within the banking industry. TOE was also utilised by Wong et al. (2019) to study blockchain adoption within Malaysian small and medium enterprises (SMES).

Many other technology adoption theories in the IS field have been utilised to identify key factors that significantly or insignificantly impact the decision to adopt technologies in organisations. Examples include UTAUT (Venkatesh et al., 2003), the Perceived E-Readiness Model (PREM) (Molla & Licker, 2005), DOI (Rogers, 1995) and the TOE (Tornatzky & Fleischer, 1990). The UTAUT and PREM Models mainly focus on examining the factors of acceptance of new technologies from a point of view of an individual and are

less focused on an organisational view. DOI is the most well-known theory for technical innovation (Lou & Li, 2017). DOI helps to predict the likelihood and the rate of adoption for a technology. This theory includes 5 innovation characteristics, including compatibility, relative advantage, complexity, trialability and observability (Rogers, 1995). This theory was not suitable for this study because the objectives of the study are set to understand the key factors of blockchain adoption and not the rate of adoption of blockchain technology.

This study requires the investigation of the key factors influencing blockchain technology within the SA banking industry from the perspectives of both views, namely individual and organisational. The TOE framework by Toratzky and Fleischer (1990) bridges this gap by incorporating an individual and organisational viewpoint. It encapsulates technological, organisational and environmental views and makes provision for the extension of potential emerging views. The TOE framework was therefore selected as the theoretical framework to help guide this study.

According to Pudjianto and Jin (2009), the Technological, Organisational and Environmental (TOE) framework is characterised as highly flexible, because it can be further extended for the acceptance of new factors and categories in the adoption of technology. This indicates that new themes and sub-themes which emerge during the data collection and analysis phase of this research will expand and contribute to the framework.

The TOE framework consolidates factors of human and non-human into a single framework, providing better advantages than other adoption models such as DOI, the Technology Acceptance Model and the Unified Theory of Acceptance Model (Li et al., 2022). It handles an organisation's traditional considerations through human actors and the "techno-centric predictions" of other technology adoption frameworks such as TAM, TRA and UTAUT (Awa et al., 2016). In addition to this, the TOE framework encapsulates and recognises the factors from the environmental context, which other frameworks such as DOI and TAM do not recognise. Additionally, Wong et al. (2019) mention that to better examine blockchain technology specifically in an organisation, the TOE framework can be utilised. According to Clohessy and Acton (2019), the TOE framework also provides a more comprehensive approach of the organisation's internal and external dynamics.

2.6.1 Technological-Organisational-Environmental Framework (TOE)

The TOE framework was used in this research study as a lens to help answer our research questions. The framework assisted the study in the development of the categorisation and for the collection of data through interviews with IT decision-makers in the South African banking industry.

The TOE framework, based on the innovation adoption theory, was developed by Toratzky and Fleischer (1990). Figure 5 below depicts the general TOE Model consisting of technological, organisational and environmental factors that organisations can use for technological innovation decision-making. The fundamental purpose of the TOE framework is to study and understand circumstances for IT adoption within an organisation (Zhu & Kraemer, 2005). Furthermore, the TOE framework has the objective of identifying three types of views, namely *technological*, *organisational* and *environmental*, which influence the adoption of technology within organisations. These views assisted in the identification of barriers to and antecedents for blockchain adoption, which is in line with our research objectives.

The TOE framework assisted in formulating our interview questions for IT decision-makers in commercial banks, to help understand the challenges for blockchain adoption. In addition to this, it also assisted with analysing the data elicited from the semi-structured interviews conducted by helping to categorise codes into themes relating to the technological, organisational and environmental challenges for blockchain adoption by SA banks. These themes helped in developing our categorisation and answering SRQ3, which is the creation of a categorisation framework constituting the expected value and the influential challenges for blockchain adoption by commercial banks from the perspectives of banking professionals in SA.

Colhessy and Action (2019) have conducted a comprehensive systematic literature review (SLR) to identify the most influential technological, organisational and environmental considerations specifically for the adoption of blockchain technology. A SLR creates a strong foundation for advancing knowledge because it unveils important considerations where research is needed (Webster & Watson, 2002). Moreover, a recent study conducted by Clohessy et al. (2021) updated and refined the TOE framework for blockchain adoption with new significant considerations. These considerations will be used as a foundation to

help guide the research. In addition to this, broader questions regarding the challenges of blockchain adoption will also be used to elicit new or emerging technological, organisational and environmental challenges as perceived by the IT-decision-makers in commercial banks in SA. Lastly, broader questions regarding the challenges of blockchain technology adoption will also be used to help extend the TOE framework.

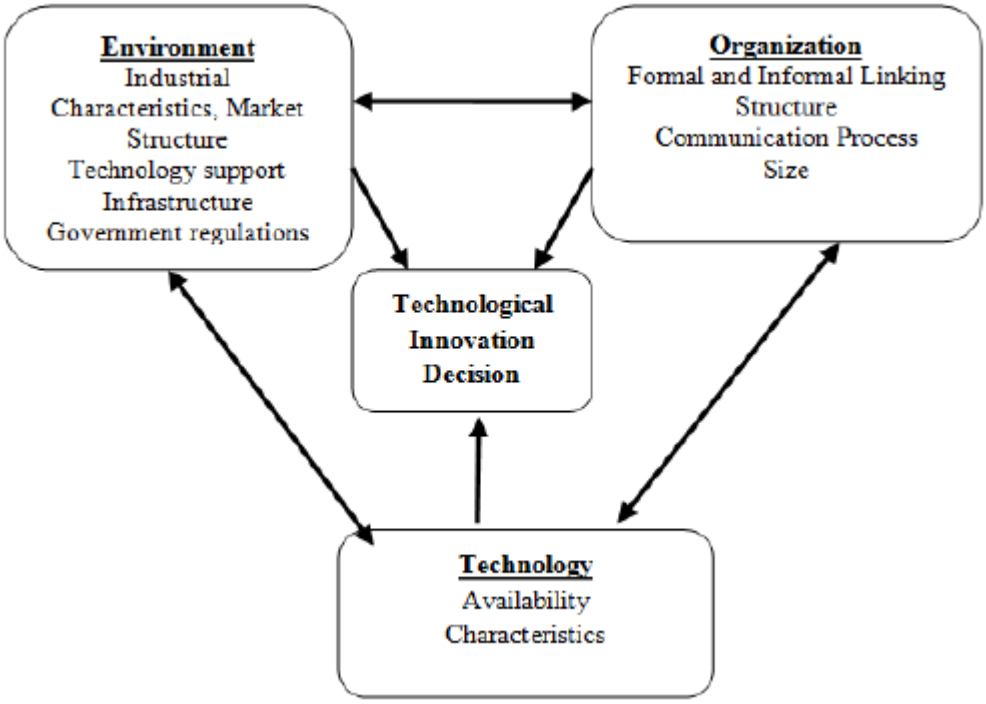

Figure 5: TOE Model (Tornatsky & Fleischer, 1990)

2.6.2 Technological Considerations

The technological element describes the availability of internal and external technology that are relevant to an organisation. The variables of the technological element influence adoption from an organisational and individual perspective. Colhessy et al. (2021) have identified two significant considerations for the adoption of blockchain technology. These considerations include perceived benefits and technology readiness.

Perceived Benefits: Perceived benefits refer to the expected value for the adoption of blockchain technology. These perceived benefits may constitute faster transactions, immutability, security and network speed (Chang et al., 2020; Golosova & Romanovs, 2018). This consideration will assist in answering SRQ1, which entails the expected value for adopting blockchain technology by banks in SA. The perceived benefits can be

understood from IT decision-makers within commercial banks in SA and blockchain experts who are knowledgeable on the expected value for blockchain adoption.

2.6.3 Organisational Considerations

The organisational element constitutes the internal factors within an organisation which influence the adoption of a technology (Awa et al., 2016). It is descriptive and refers to the availability and use of an organisation's resources (Ali et al., 2020). Colhessy and Action (2019) have identified and explored two significant organisational considerations for blockchain adoption, which will be used as a lens of this section in our framework. The most identified organisational consideration for blockchain adoption includes top management support. Top management support within banks is an important consideration because the adoption of blockchain technology may involve new regulatory requirements. This would require higher level support within banks such as the approval for the potential adoption of blockchain technology. In addition to this, the readiness of an organisation in terms of organisational capabilities is also an important consideration for organisational blockchain adoption.

Top Management Support: This consideration is a recurrent identified influential factor for adoption of emerging and disrupting technologies (Wang et al., 2016; Clohessy & Action, 2019). Top managerial support entails the managerial beliefs of high level managers, such as IT decision-makers, for the adoption of technological innovation and their extent for advocating the adoption of such innovation. Top management support within banks is an important consideration because the adoption of blockchain technology may involve new regulatory requirements, which would require the insight, permission and advocation of appropriate professionals within banking institutions.

Organisational Readiness: This consideration refers to the readiness of banking institutions in terms of their existing organisational capabilities. The existing organisational capabilities entail elements of financial and human resources such as budget and skills within the organisation necessary for the adoption of technology (Semenova, 2020). Organisational readiness will allow the researcher to elicit insight on the capabilities of IT adoption by banks in the South African context.

2.6.4 Environmental Considerations

The environmental element focuses on the influential factors for adoption that are external to an organisation's operations. For banking institutions in SA, factors may include regulatory influence (Ali et al., 2020) and industry pressure. These considerations are explained below.

Regulatory Environment: The regulatory environment encompasses the governmental regulation which may have an impact on the adoption of blockchain technology. This is a significant consideration for blockchain due to the uncertainty of regulation for cryptocurrencies within SA. In addition to this is industry pressure.

Industry Pressure: Due to blockchain technology constituting the term "hype technology" (Kawasmi et al., 2020), as well as being a disruptive technology (Frizzo-Barker et al., 2020), competitive pressure is seen as a consideration as a barrier to the adoption of blockchain in banks. FinTech start-ups were early-adopters for the adoption of blockchain, quick to provide banking services to banked and unbanked individuals, promoting financial inclusion (Angelis & Ribeiro da Silva, 2019; Larios-Hernandez, 2017). In addition to this, the competitive pressure amongst banks in SA can also be used to help formulate interview questions for each IT decision-maker amongst these banks. Using industry pressure as a consideration when eliciting information from banking professionals may identify specific challenges for the adoption of blockchain in the SA context.

2.7 CONCLUSION

This chapter highlighted key findings from previous literature, white papers and SA banking institution reports pertaining to blockchain technology and blockchain technology adoption. The literature review provided an understanding of what blockchain technology is by explaining its mechanisms, key characteristics, evolution over the years and the motivators and challenges for adopting blockchain technology within the banking industry. In addition to this, various theoretical frameworks were considered with reasons for this study, and the motivation for the selected framework, TOE, was presented. Various TOE considerations were identified and explained which included perceived benefits, top management support, organisational readiness, regulatory environment and industry pressure.

PART III – RESEARCH DESIGN AND METHODOLOGY

Part III consists of Chapter 3 and the research design and methodology of the study. Figure 6 depicts the progress of the study.

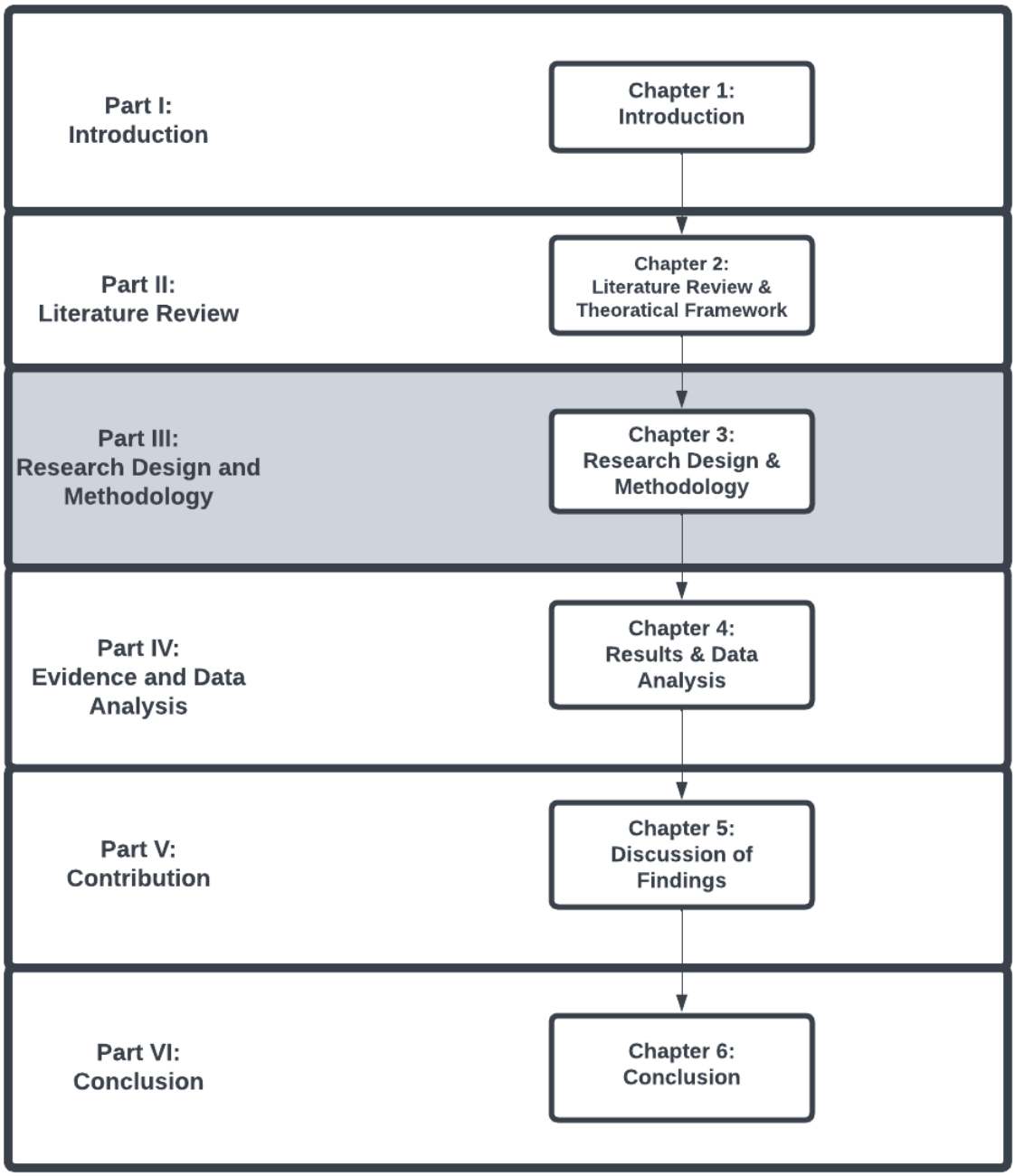

Figure 6: Part III – Research Design and Methodology

3 RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter provides a detailed understanding of the methodological approach taken in this study. It presents the philosophical assumptions which underpin the research. This includes the selected research philosophy, the research paradigm, as well as the selected research approach. It further details the research strategy, the research choice, the selected time horizon, the data collection methods and the data analysis method. This study applies a qualitative case study methodology to explore the influential factors facilitating the adoption of blockchain technology in the South African commercial banking industry.

3.2 RESEARCH DESIGN

This study utilised the “onion” metaphor developed by Saunders et al. (2009) to help guide the research design. The research onion is illustrated in Figure 7 and assisted in selecting the appropriate research philosophy, approach, strategy, choice, time horizon and lastly the data collection and analysis methods. Saunders et al. (2012) state that each layer “peeled” in the onion should primarily focus on answering the research questions, and therefore the “peeled” layers may differ depending on the problem being addressed. This research paper therefore utilised Saunder’s (2009) onion as a guide and also selected the research items based on the objectives and research questions of the study.

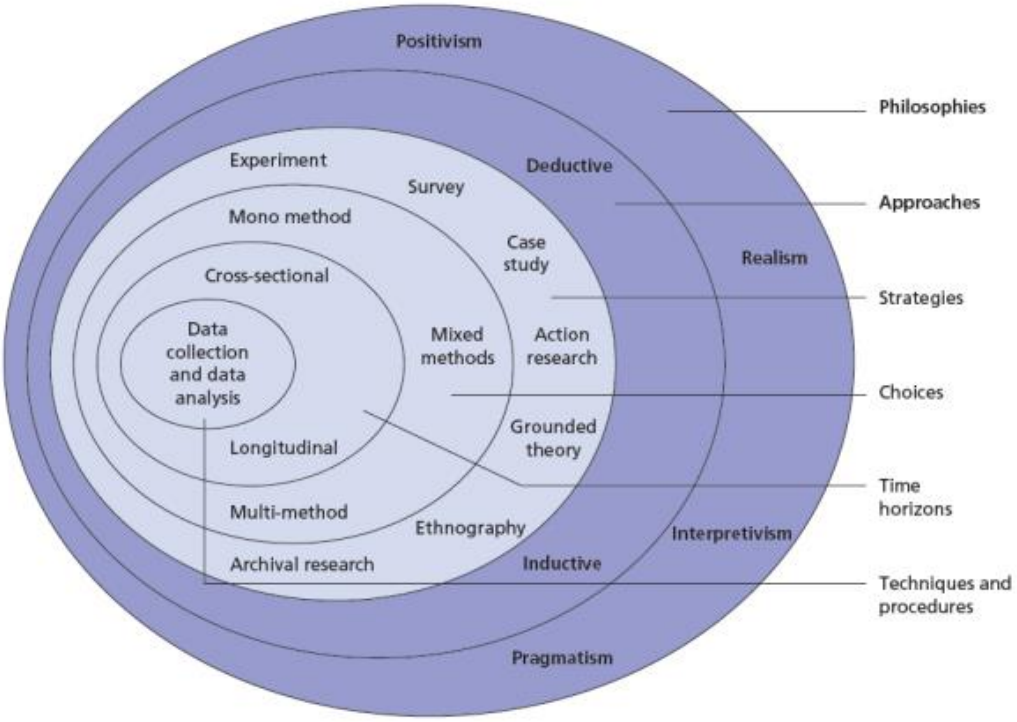

Figure 7: Saunders Research Onion

Source: Adapted from Saunders et al. (2019)

3.2.1 Research Philosophy

The first layer refers to the research philosophy. This layer is based on the creation of knowledge and the manner in which the knowledge is created (Saunders et al., 2009). This research study followed an interpretivist philosophy. Interpretivism can be viewed as an attempt to understand the world from a social context. It includes the subjective views and experiences of individuals (Klein & Myers, 1999). This research intended to seek the views and knowledge from various banking professionals and blockchain experts (discussed in Section 3.3.1) to better understand the phenomena encompassing the adoption of blockchain in the SA banking industry. Methodologies which encompass meaning, such as interviews and observations, are used in interpretivist studies, whereas methodologies which encompass measurement and numeric data are used in positivist studies (Saunders et al., 2013). A positivist philosophy entails the creation of hypothesis, which is strongly based on previously observed relationships between variables. In addition to this, a positivist philosophy constitutes an objective research design which is concerned with numerical data which can ultimately be tested.

This study followed an interpretivist philosophy. The TOE framework in Section 2.5 was chosen as the lens for this research, using technological, organisational and environmental views to guide the research and answer the proposed research questions. In this study, the research questions were set to explore and understand the adoption of blockchain technology within the banking industry in SA. A positivist approach would therefore not be appropriate for this study, because a positivist approach is strongly based on the creation of hypothesis, whereas this study focuses on interpretation of human knowledge.

Moreover, according to Saunders et al. (2003), an interpretivist philosophy can be understood under the features of ontology, epistemology and axiology. The features of ontology, epistemology and axiology will be discussed below in relation to this research paper.

3.2.1.1 Ontology

Ontology is defined as the nature of the world and what constitutes reality. In interpretivism research, the view of the world is not limited to a single set reality. Instead, it can depict multiple realities in which a situation in interpreted (Saunders et al., 2009). This means that reality constitutes humans' subjective experiences of the external world. There is not a single truth about the phenomena, as humans each have their subjective view. The reality of the phenomenon of interest can be explored, through interactions with humans and actions which bring meaning (Goldkhul, 2012). The nature of exploration is applicable to this study in the purpose of understanding the potential factors which are hindering, as well as potentially influencing, the adoption of blockchain within the South African banking environment. In addition to this, Leitch et al. (2010) explain that within the interpretivist philosophy, the reason that multiple social realities exist is due to the diversified experience, views and knowledge that individuals possess. An interpretivist ontology entails that reality and our knowledge of reality are social products created by humans. Moreover, reality is only understood through the social actors who construct and maintain these realities. In the context of this study, blockchain technology is the reality created by humans and is maintained by those interested in its adoption and development.

3.2.1.2 Epistemology

The epistemology is the concern for knowledge, how to obtain it and the limitations thereof (Myers, 2013). From an interpretivism view, knowledge is contextual, which allows the researcher to understand a specific context. The context for this study refers to the South African banking industry. The researcher believes that reality is socially constructed and considers knowledge valid from IT decision-makers and blockchain experts in SA who meet the inclusion criteria stipulated in Section 3.3.1. Moreover, in interpretive research, there are multiple subjective realities (Klein & Myers, 1999). In this study, the IT decision-makers from commercial banking institutions and various blockchain experts may have differing insightful views on the adoption of blockchain, based on their experience around IT adoption and blockchain. These views can be seen to shape the social reality surrounding the phenomenon of blockchain adoption within the South African context. The subjective views from these professionals can provide information relating to potential challenges of adopting blockchain, as the environment in which they work provides them with the knowledge and experience regarding blockchain technology. In addition to this, blockchain experts are also seen to have information regarding the expected value of blockchain adoption. These experts have high experience in the FinTech industry and blockchain projects. FinTech is viewed to pose change to the future of how banks' business will operate (Hassani et al., 2018).

3.2.1.3 Axiology

The axiology is concerned with the role, judgements and values of the researcher (Saunders et al., 2009). The researcher will play an active role in the conducting of research. This will allow the researcher to understand the phenomena better. The researcher will assume an empathetic stance and will therefore view the reality of blockchain adoption according to the interpretation of the participants' view of reality. Finally, the researcher will keep an open mind to any new knowledge on the adoption of blockchain, even if research is conducted with prior insight.

3.2.2 Research Approach

Saunders et al. (2009) suggest two types of approaches when conducting research, namely inductive and deductive approaches. A deductive study tests theories against realities, whereas an inductive study forms theories or may derive new insights which are based on a selected phenomenon (Saunders et al., 2012).

This study does not intend to derive inferences and write up conclusions based on the frequency of an occurrence, which would suggest a quantitative research study. In addition to this, this study did not intend to use hypothesis testing as an attempt to verify or falsify a particular concept, indicative of a deductive approach (Saunders, Lewis and Thornhill, 2009). Contrastingly, this study follows an inductive research approach which is congruous with qualitative research. It is noted that both approaches are likely to entail components of one another. In an inductive approach "data collection is used to explore a phenomenon, identify themes and patterns and create a framework" (Saunders et al., 2012:144). This research study will follow an inductive approach in its effort to understand the factors of blockchain adoption in the SA banking industry. Figure 8 provides an illustration of the inductive approach and will be explained below.

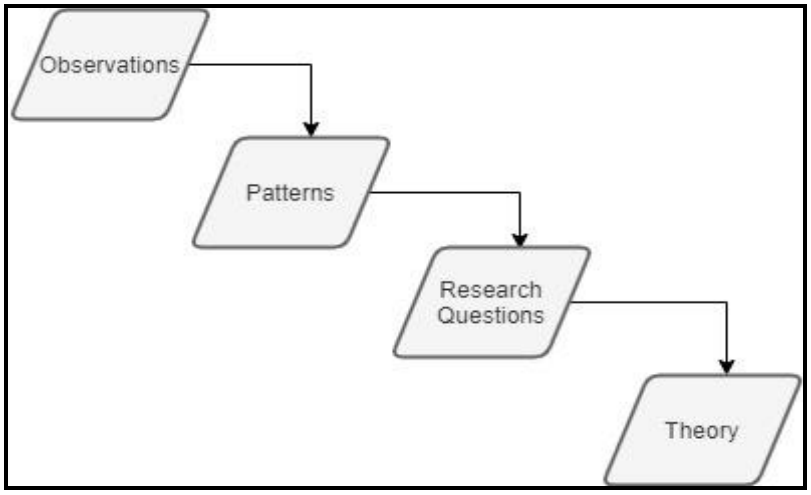

Figure 8: Inductive Approach

Source: Adapted from Leitch et al. (2010)

The inductive process illustrated in Figure 8 starts with observations and results in the derivation of theory. An inductive approach allows for flexibility and allows for changes to the research emphasis during the progression of the research (Saunders, Lewis & Thornhill, 2009). This indicates that the research questions may be altered or evolve as the research progresses. Moreover, it is also important to note that observations within this context do not refer to the viewing of the investigated phenomenon, however, it refers to

the data which will be gathered through the conduction of the interviews. These observations may include recordings and fieldnotes which will be utilised when conducting the research. In addition to this, the use of the word “Theory” in Figure 8 is explained by Bell et al. (2019) as either resulting in the development of new theory or the creation of new insights of a specific phenomenon. This research study anticipates new insights regarding blockchain adoption, through the conduction of interviews with IT decision-makers and blockchain experts in the SA context. The categorisation framework will also constitute the “theory” element. The inductive process for the context of this research illustrated in Figure 8 is explained below.

The first step will be to conduct the observations during the interview process. Next, the identification of patterns through the analysis of data explained in Section 3.5 will be conducted by the researcher. Once relevant patterns have been identified, they will be mapped to the research questions, allowing the opportunity for any important changes or evolvements of the research questions, as described above. Finally, these research questions will be mapped back to theory. As a result, this will allow the researcher to extract comparisons between the results which were analysed with the literature supplemented. This can therefore also result in new insights being brought forward.

3.2.3 Research Choice

This study used a qualitative mono-method as the research choice (Saunders et al., 2019). The selected research philosophy for this study plays an important role in the research choice to be selected. Due to the selected philosophy, a qualitative research method is deemed appropriate for this study. Interpretivism is subjective in nature and the participants’ responses will therefore be based on their knowledge on blockchain technology and IT adoption experience. This allows the researcher to analyse the data to better understand the participants’ experienced knowledge and views of blockchain adoption in the SA banking industry. This also implies that a non-numerical research method is more appropriate for this study.

3.2.4 Research Strategy

There are several research strategies which align to interpretive research. Some of these research strategies include grounded theory, case study, ethnography and survey

research. Grounded theory research is a suitable research strategy for interpretivist research, as it allows the researcher to develop a new theory based on the experiences and perspectives of the participants, and it is an iterative process of data collection and analysis that can be refined as the research progresses. Case study strategies are well suited for interpretivist research as they allow for in-depth exploration of a particular context or phenomenon. Ethnography is also a suitable research strategy for interpretive research as it involves immersing oneself in a particular cultural group and provides a deep understanding of the beliefs, values and practices of the participants from their own perspectives. Survey research was the chosen research strategy because it allows the researcher to identify various participants from different groups who are knowledgeable in blockchain technology aligned to the purpose of the research study. The following section details why survey research was selected for this research study in comparison to other appropriate research strategies.

Survey Research Strategy

Denzin and Lincoln (2011) state that there is a practical link between the choice of philosophy and research strategy to collect and analyse data by a researcher. The chosen research strategy appropriate for this study was a survey strategy, as the researcher aimed to retrieve information from subjects who are knowledgeable on the adoption of blockchain technology by banking institutions and blockchain experts in the SA context.

Saunders and Tosey (2013) state that a research strategy should help to answer the objectives or questions of the research study. In addition to this, Saheb and Mamaghani (2021) have recently used survey research to explore the organisational value of blockchain adoption in the banking industry, through the conduction of semi-structured interviews with experts in the topic of blockchain and employees within banking institutions who could provide insight on the value of blockchain adoption within their organisations. According to O'Leary (2008), when a technology is still in the stages of exploration and experimentation, it is strongly recommended to conduct interviews with experts to gain insights on their opinions for the potential challenges and value of the technology adoption. Blockchain technology is still in its stage of exploration and insight from various experts will be valuable for this research study.

Moreover, a survey research strategy can constitute quantitative or qualitative data. Kelley et al. (2003) argue that survey research is suitable for hypothesis testing and data provision, as well as to obtain explanations and to investigate elements of the given phenomenon. This study used a survey strategy to obtain explanations and investigate the influences of blockchain adoption by commercial banking institutions in SA. A survey can be used to elicit information from a limited number of subjects who are highly knowledgeable on the topic of interest, and who are willing to provide their insights intended to represent a larger sector (Kelley et al., 2003). Finally, a survey research strategy will assist in achieving our research objectives of exploring the influences of blockchain adoption in the SA banking industry.

Furthermore, a survey research design was more appropriate than a case study strategy because data collection is more flexible to different targets in survey research. This means that semi-structured interviews can be conducted with participants from various commercial banking institutions in SA, as well as experts in the matter of blockchain who work in the financial industry in SA, rather than focusing on a particular commercial bank in SA. Having insights from participants working within the commercial banking industry will provide a deeper insight into the organisational element of the chosen TOE framework lens, whereas having insight from experts in blockchain will help to explore the expected value for adoption.

3.2.5 Time Horizon

According to Saunders et al. (2016), time horizons can either be longitudinal or cross-sectional. A cross-sectional time frame is suggested when the nature of technology being researched is constantly changing. Furthermore, a cross-sectional time frame takes a snapshot of the phenomena of interest at a single point in time (Kelley et al., 2003). This is appropriate for the adoption of blockchain technology. Toufaily et al. (2021) suggest that researchers explore the impact and potential of blockchain throughout its ‘hype-cycle’. The ‘hype-cycle’ causes the nature of the technology to constantly evolve. Therefore, this research study uses a cross-sectional time horizon.

3.3 SAMPLING

The following section describes and motivates the selected sampling approach in terms of target population, the sampling method and the sample size.

3.3.1 Target population

The interview survey firstly targeted IT decision-makers employed within business units of commercial banks in SA which met the inclusion criteria of Informant A in Table 1. IT-decision-makers had to possess an adequate amount of knowledge on new technologies to be adopted in an organisation and be classified as having authority to approve the decision of IT adoption in an organisation. IT decision-makers might undertake the roles of IT managers, IT executives, IT heads, chief technology officers, chief information officers and chief security officers. These decision-makers might be from any of the 15 commercial banks recognised by the South African Reserve Bank in their directory of 'locally controlled banks' on their official website. These banks include ABSA, African, Bidvest, Capitec, Discovery, FirstRand, GrindRod, Investec, Nedbank, Sasfin, Standard Bank, UBANK and Thyme bank.

The researcher targeted experts in blockchain technology within SA who met the inclusion criteria of Informant B in Table 1. Blockchain experts had to have 5 years of experience in IT or FinTech and have a postgraduate degree in IT, finance or similar areas. The knowledge of blockchain experts will put a strong focus on understanding the technological influences of blockchain adoption of banks, as well as to help answer SRQ1. Participants were identified and selected through LinkedIn.

Table 1: Target Population Inclusion Criteria

Informant	Participant Targeted	Role Type(s)	Minimum Experience	Criteria
A	**IT Decision Makers of Commercial Banks in SA**	• IT Managers • IT Executives • IT Heads • Chief Technology Officers • Chief Information Officers • Chief Security	3 Years in the Financial or IT Industry	Must be currently employed by a SARB Recognised Commercial Bank

		Officers • Senior and Mid-Level IT Consultants • Or similar with IT-Decision-Making Experience		
B	**Blockchain Experts in SA**	• Founder / CEO of Blockchain / FinTech Based Start-up • Blockchain Consultant / Advisor	5 Years in the IT or FinTech Industry	Must Possess an IT, Financial or Similar Post-Graduate Degree

3.3.2 Sampling method

This study utilises non-probability sampling techniques. A non-probability sampling technique is based on judgement and does not involve random selection, as with a probability sampling technique (Sharma, 2017).

Various useful non-probability sampling techniques are used, including convenience, snowball, and purposive techniques. Convenience sampling is the most common type of sampling used, because it is efficient, cost effective and easy to implement. Purposive sampling allows for selecting participants who must meet a criterion such as experience or education. Purposive sampling was more appropriate for this research study because the targeted population required careful selection by the researcher. In addition to purposive sampling, the snowballing technique was also used to identify participants. The purposive and snowballing sampling techniques are explained below.

3.3.2.1 Purposive Sampling

This study utilised the purposive sampling technique which involves the identification and selection of subjects who are knowledgeable and experienced on the phenomena of interest. Purposive sampling is also known as judgement sampling. The phenomena of interest in this study refers to blockchain technology and blockchain technology adoption in commercial banks in SA. The purposive sampling technique was used in this research

study to target participants who have relative experience working in commercial banking institutions within SA and experts in blockchain technology in the SA context. Moreover, selecting this technique allowed the researcher to select participants who met the requirements stipulated in Table 1.

3.3.2.2 Snowball Sampling

In addition to purposive sampling, the snowball sampling technique was also used. The snowball technique helped identify additional subjects of interest through the reference of current participants and other people. This study utilised the snowball technique once key informants of the study had already been selected through the purposive sampling method. The key subjects selected were asked if they could assist by referring new potential participants which they may have known, who could provide information about blockchain adoption in banking institutions.

3.3.3 Sample size

Trotter (2012) advises that a sample size in qualitative research should not be so large that it is problematic to mine prolific and rich data, nor should it be too small where data saturation becomes challenging to obtain. Decision-makers encompassed a larger sample size than blockchain experts. This is because decision-makers can provide rich information on blockchain adoption challenges and expected value, whereas blockchain experts can provide rich information on just the expected value of adoption for banks in SA. According to Onwuegbuzie (2007), a smaller sample size is appropriate when participants possess expert knowledge in a particular field of knowledge. The sample size of 9 was appropriate for this study because blockchain experts possess expert knowledge on the topic of blockchain and IT decision-makers possess expert knowledge on the topic of technology adoption. These 2 areas of knowledge are aligned to the main purpose of the research study, which includes understanding the factors influencing the adoption of blockchain technology within the SA banking industry.

Additionally, availability of participants from the IT decision-making sector was low due to privacy concerns of the participants' organisations. The researcher had difficulty finding IT decision-makers employed within the SA commercial banking industry due to the information required from each participant. Participants declined the interview request

because they did not want to insinuate current or future plans regarding their intentions towards blockchain adoption.

3.4 DATA COLLECTION

To achieve the objectives of this research study, a qualitative approach was pursued in the collection of primary data from appropriate IT decision-makers of commercial banks and blockchain experts in SA in the form of semi-structured interviews. Clemons and Weber (1990) consider the financial sector as an information intensive sector at the front line of technology applications.

In addition to the interviews that were conducted, secondary data was collected in the form of documentation including official white papers, journal articles, corporate websites and annual reports to further support and compliment the objectives of the research study as well as the interview process.

Once the semi-structured interviews were completed, the retrieved data was then transcribed for analysis and transformed into hard data for concise reading and understanding. The data was then analysed and categorised into relevant themes to help answer our research questions.

3.4.1 Interviews

Interviews are viewed to be an effective and important technique for the collection of data from people (Myers, 2013). They are commonly used in qualitative research and are well suited for interpretive studies (Saunders et al., 2009; Leitch et al., 2010). Moreover, Qu and Dumay (2011) have highlighted 3 different classifications of interviews. These include structured, unstructured and semi-structured interviews. Structured interviews encompass a set of predetermined and standardised questions to ensure consistency across interviews. Structured interviews, however, limit the option to ask follow-up questions. Structured interviews therefore restrict further insight from participants for elaboration on a specific topic or point from the asked question. Contrastingly, unstructured interviews have no predetermined set of questions to ask. The interviewed participants can speak about their views on the introduced topic. The drawback of using unstructured interviews is that it may produce large amounts of text or data that is not necessarily rich in quality. This

requires the interviewer to establish rapport and it is also crucial for the interviewer to know when to probe with further questions (Qu & Dumay, 2011). If the interviewer is not well trained and prepared before conducting the interview, irrelevant or low-quality data may be extracted.

To ensure that all essential information was obtained, semi-structured interviews were conducted with chosen participants as the primary data collection method. The interviews were conducted virtually through Zoom and Google Meets, as well as face-to-face.

Semi-Structured Interviews

Semi-structured interviews allow for the benefits of both structured and unstructured interviews. The researcher may ask predetermined open-ended questions which can be used to guide the interview process and provide the researcher flexibility to follow-up on specific items. With semi-structured interviews, the interviewer creates a list of predetermined questions prior to the interview, however, additional relevant issues may be raised during the interview which the interviewee considers important. This makes provision for additional insights towards the research objectives. Pre-determined questions were formulated with the guidance of the TOE considerations mentioned in Chapter 2, as well as broader questions to make provision for new information concerning the emerging challenges of blockchain adoption by banks in SA.

Moreover, semi-structured interviews allow the researcher to guide the interview process and focus the interview on helping to achieve the study's research objectives. This allows for open-ended questions to guide an in-depth understanding of the phenomena of interest, which is blockchain technology adoption by banks in SA. Section 3.5 details the interview guide pillars by explaining each interview question and its corresponding purpose.

Compared to a written questionnaire survey, semi-structured interviews permit the researcher to interact with participants. In addition to this, semi-structured interviews also allow new themes and topics to emerge, creating new streams of interest which the researcher could take on. Moreover, they allow the researcher to pose further questions when the interviewer encounters well known biases of a particular phenomenon (Busetto et al., 2020).

Express permission from all chosen participants was obtained to audio record each interview. The audio recordings of each interview were then transcribed into text using Otter.AI and were sent back to key participants for approval and additional feedback.

In conclusion, the semi-structured interview method was deemed appropriate for this research study because it is aimed to extract in-depth data and information from IT decision-makers in SA about the challenges for blockchain adoption in commercial banks, as well as the perceived expected value for blockchain adoption in commercial banks. This data collection method is flexible, which can be useful for extracting information from interview participants. Semi-structured interviews can also help to unlock the concealed aspects of organisational and human behaviour (Myers & Newman, 2007).

3.4.2 Documents and Secondary Data

There is a plethora of documents that are accessible on the internet in relation to blockchain adoption by banking institutions. Blockchain is still in its exploratory stage of Gartner's hype-cycle and the secondary data stipulated in Section 2.3 of the literature review was therefore useful in supporting the primary data retrieved. These documents and secondary data included but were not limited to white papers, journal articles and SA banking institution reports. These documents supplemented the primary data and allowed the confirmation of findings.

3.5 INTERVIEW GUIDE PILLARS

This section encapsulates the pillars which categorised the interview questions answered by the participants. There are a total of 5 pillars which helped to structure the interviews and results of the interviews. These pillars include introductory, value, technological, organisational and environmental. Each of these pillars followed a sequential structure in line with the interview questions. Table 2 below depicts each interview pillar with its relative interview question for Participant Group A. In addition to this, Table 3 depicts each interview pillar and its respective interview questions for Participant Group B. Moreover, each of these tables also presents the purpose of each interview question which was asked of participants. Table 2 consists of pillars including all elements of introductory, value, technological, organisational and environmental. However, Table 3 only consists of

pillars of introductory and value. The reason for this is that participants from Participant Group B were only required to provide the expected value for blockchain adoption, whereas participants from Participant Group A were required to provide both expected value and challenges for blockchain adoption. An explanation of each pillar and the results of the responses from each interview question are presented in the following sections.

Table 2: Interview Guide Pillars - Participant Group A

Interview Pillar	Interview Question	Purpose
Introductory	• Can you please provide information on your experience with IT adoption?	To determine the background and experience of the IT decision-makers
Value	• In your opinion, what benefits do you think blockchain technology could have on South African commercial banks if it is adopted within your organisation?	To gain an understanding from an *internal* perspective of a commercial bank in SA on the potential benefits of blockchain technology in the South African banking industry
Technological	• Do you think your organisation is technologically ready for the adoption of blockchain technology?	To gain a better understanding of the reasons the participants believe that their organisations are prepared or unprepared for adopting blockchain technology
	• Can you please explain why or why not?	
	• Can you think of any other technological factors which may hinder the adoption of blockchain technology in your organisation?	To determine any other possible technological challenges for the participant's organisation to adopt blockchain technology
Organisational	• How aware are other IT decision-makers in your organisation of the adoption of blockchain technology?	To determine the level of awareness of blockchain technology amongst senior management and other IT decision-makers in the organisation

	• In your opinion, is the support of top management within your organisation considered as an important factor in the decision for adopting blockchain technology? • Why do you say this?	To determine whether the support of top management in the organisation of participants is considered important, specifically for blockchain adoption.
	• Can you think of any other organisational factors which may hinder the adoption of blockchain technology within your organisation?	To determine any other possible organisational challenges for the participant's organisation to adopt blockchain technology
Environmental	• Do you think that the regulatory environment may have an impact on the adoption of blockchain technology within your organisation? • Why or why not?	To determine how the regulatory environment would have an impact on blockchain adoption in the participant's organisation
	• In your opinion, will industry pressure or competitive pressure make an impact in the decision to adopt blockchain technology within your organisation? • Why or why not?	To determine whether the pressure from industry or competitors will influence the participant's organisation to adopt blockchain technology
	• Can you think of any other environmental factors which may hinder the adoption of blockchain technology within your organisation?	To determine any other possible environmental challenges for the participant's organisation to adopt blockchain technology

Table 3: Interview Pillars - Participant Group B

Interview Pillar	Interview Questions	Purpose
Introductory	• What is your experience with blockchain and/or financial technology?	To determine the experience relating to blockchain or financial technology possessed by the blockchain experts
	• Do you have any blockchain related projects published? • If yes, can you please provide more information on the project?	To gain a further understanding on the knowledge of blockchain experts and determine whether and what blockchain projects the participants had worked on
Value	• In your opinion, what benefits do you think blockchain technology could have on South African commercial banks if it is adopted within their organisations?	To gain an understanding from an external perspective of a commercial bank in SA on the potential benefits of blockchain technology in the South African banking industry

3.6 DATA ANALYSIS

A thematic analysis (TA) has been selected to analyse the primary and secondary data collected in the data collection section of this research study. A description of what a TA is and how the TA will be conducted is detailed below.

3.6.1 Thematic Analysis

TA is a data analysis technique which analytically identifies, organises and evaluates data into relative themes and patterns, strengthening the structure of the analysis (Vaismoradi et al., 2013). This method of analysis allows the researcher to make sense of the data created through the interviews conducted and to identify repeated patterns to create a shared meaning. By using a thematic analysis in this study, the researcher can categorise the information extracted from the interviews into various relative blockchain related themes. The thematic analysis has the purpose of decomposing text, such as interview transcripts, into content of smaller units and then managing these units through a

descriptive analysis (Vaismoradi, Turunen & Bondas, 2017). Moreover, a TA is a flexible means of data analysis, which makes it useful in the analysis and collection of rich and in-depth data, including semi-structured interviews and secondary sources of data such as whitepapers, official documents from various relative companies and journal articles.

A thematic analysis helps to unpack issues which participants may generate during the interview process by identifying and outlining factors and variables which influence the generated issue (Vaismoradi et al., 2013). Therefore, the data analysis method of a TA assisted this study in identifying the factors which may influence the adoption of blockchain technology, as well as the challenges which commercial banks in SA may encounter.

Once the interviews were conducted and recorded, the recordings were transcribed utilising the transcribing software Otter.ai. This software assisted in transcribing the audio of the interviews to text. Once the recordings were transcribed, they were manually reviewed to eliminate any inconsistencies in the text. Qualitative data analysis software (QDAS) was then used to analyse the data. The utilisation of software is recommended when conducting a thematic analysis, as it increases the reliability in qualitative studies (Leech & Onwuegbuzie, 2011). The chosen QDAS for this study is ATLAS ti 9 and it was used to conduct the TA through the categorisation of themes and sub-themes. It also assisted with the transcribing of the audio taped interview transcripts.

The analysis was guided in line with Braun & Clarke's (2006) 6 step guide for a thematic analysis. The steps taken for this study are described below:

1. **Familiarisation of Data**

   Once the interviews were transcribed with Otter.ai and reviewed, the researcher read and re-read each transcript to develop a better understanding of the data. Notes were taken to initiate the second stage of the TA, the generation of initial codes.

2. **Generating of Initial Codes**

   In this stage, the researcher organised the data in a systematic way that created meaning of the transcripts and literature constituting the TOE framework in Section 2.6. Initial codes were created based on the understanding of the transcripts by the

researcher and the influential TOE considerations identified in Sections 2.5.2 - 2.5.4 to guide the process of generating the initial codes. In addition to the TOE considerations from the framework, the researcher identified new emerging technologically, organisationally or environmentally related codes. Moreover, at this stage, the researcher also identified new elements of the TOE framework, extending the framework. There were various codes generated from the transcripts, which were in line with our research questions to ensure meaningful codes. These codes were then reviewed and prepared for the third stage of the thematic analysis.

3. **Searching for themes**

   Searching for themes entails the combination of codes into overarching themes which will display the data more precisely (Braun & Clarke, 2006). In this stage, the initial codes that were generated in Stage 2 were transformed into themes that helped to categorise the research findings. The themes were searched for the categories of technology, organisation and environment, which is in line with our theoretical TOE lens.

4. **Reviewing themes**

   In this step, the quality of the themes identified in Step 3 were verified. The themes were once again assessed against the existing collated data set. The searched themes were aligned to literature, documents and secondary data collected such as white papers, company reports, project plans etc., to ensure confirmability and credibility of the themes identified.

5. **Defining and naming themes**

   Each theme needs to be unique and will encompass a clear explanation for each theme. The themes were required to address the research questions and should not overlap with other themes. Primary themes of challenges and expected value were defined in this step under the categories guided by the TOE, as well as emerging secondary themes and key considerations from the previous steps.

6. **Producing the report**

   In this phase, the coding and analysis was completed. The final step constitutes all of the primary and secondary themes identified in the previous steps to develop a

story. The researcher extracted important data to develop an analytical narrative which was used to explain the data. The primary and secondary themes entailed the expected value and technological, organisational and environmental challenges identified for the adoption of blockchain in SA commercial banks. The primary and secondary themes identified were used to create the categorisation framework for IT decision-makers in banks in SA and other developing countries, to help with strategy creation to accelerate blockchain adoption.

3.7 QUALITY ASSESSMENT

To ensure the reliability of the data, the researcher applied measures of credibility, confirmability and dependability. These measures are described below.

3.7.1 Credibility

The researcher ensured that the views of the interviewed participants reflected their views without any alteration or adjustment to the original data. Data triangulation was used by interviewing IT decision-makers from more than one commercial bank. This allowed for the views and knowledge of more than one organisation. In addition to this, triangulation would also be achieved through the collection of data from participants of differing IT decision-maker roles within SA commercial banks. This included the roles stipulated in Table 1. In addition to collecting data from differing IT decision-maker roles, data was collected from multiple commercial banks. This ensured informants who represent diverse perspectives of the phenomenon and contribute their different perspectives to the challenges of adopting blockchain technology within their organisations (Watkin, 2012).

3.7.2 Confirmability

Confirmability was applied by the researcher through inter-subjectivity. The researcher took notes during the interview process with the key points on the main topics of the interview and sent it back to key participants of the study to ensure that they agreed with the inferences derived by the researcher during the interview process.

3.7.3 Dependability

For interpretivist research, to ensure dependability, researchers must provide adequate detail regarding the phenomena of interest and its social context in which it is embedded

(Watkins, 2012). Dependability was achieved by providing details regarding the participants in terms of the inclusion criteria in Table 1. Providing details regarding the criteria for selecting the specific participants will allow readers to independently authenticate the research.

3.8 ETHICAL CONSIDERATIONS

The participants interviewed were clearly informed that they had the option to remain anonymous during the interview process. The researcher took a responsible approach to ensure that confidentiality was maintained at the participants' request. Commercial banks may not want their names included due to privacy or competitive advantage reasons. The researcher therefore ensured complete anonymity for participants who chose to remain anonymous. The researcher also sought the consent of participants for the recording of interviews. Each participant had the option to withhold their voices from being recorded. Additionally, compliance with ethical considerations was acquired by obtaining permission from the University of Pretoria in the form of ethical clearance which is attached in Appendix D.

3.9 CONCLUSION

This chapter aimed at detailing the research design components of this study. The research onion by Saunders et al. (2019) was used to guide the design of the study. This included identifying the selected research philosophy, approach, strategy, choice, time horizon and data collection and analysis techniques. The interview guide pillars for the study were also discussed. This chapter further detailed the sampling approach in terms of the target population, sampling method and sample size. Finally, a discussion of the choice of the data analysis method was presented.

The details of the design of the research study were discussed in Section 3.2. The study employed an interpretive research paradigm because the nature of the study required interaction with participants to help understand the participants' opinions on the key factors influencing blockchain adoption in the SA banking industry. The study also followed an inductive research approach and a cross-sectional time horizon. In addition to this, the study employed a purposeful sampling approach to identify participants who were knowledgeable on the topic of blockchain adoption in the SA banking industry. The

snowball sampling technique was further employed to help identify additional participants through the participants who were initially identified by using the purposeful sampling approach. Semi-structured interviews and secondary data were used as data collection methods for this study. A thematic analysis was used to analyse the data of this study. This chapter was concluded with an overview of the quality assessment factors and ethical considerations followed for the study. The quality assessment factors included credibility, confirmability and dependability, whereas the ethical considerations included anonymity, confidentiality, informed consent and obtainment of ethical clearance.

PART IV – EVIDENCE AND DATA ANALYSIS

Part IV consists of Chapter 4 and entails the evidence and data analysis of the study. Figure 9 depicts the progress of the study.

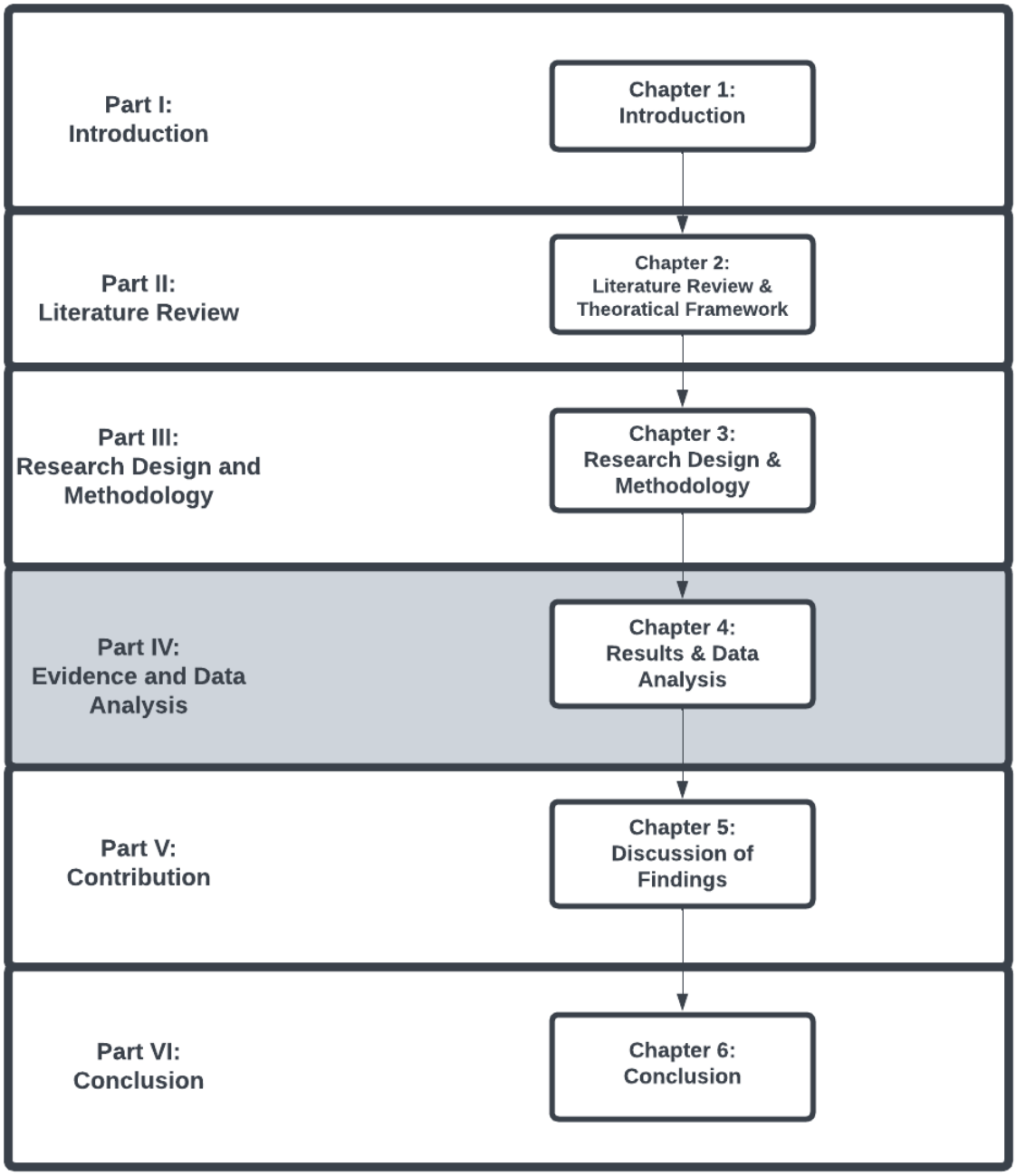

Figure 9: Part IV – Evidence and Data Analysis

4 RESULTS AND DATA ANALYSIS

4.1 INTRODUCTION

This chapter firstly introduces both participant groups and the respective participants pertaining to each group. The next section of this chapter introduces and presents the interview pillars which were used to structure the results and interview questions. It then presents the findings from the semi-structured interviews that were conducted with the 9 participants for this study. Each interview question is categorised with its relative interview pillar and the responses of participants are then presented. The next section of this chapter entails a data analysis and presents the emerging themes and key considerations identified during the analysis. Finally, each theme is described and prepared for the discussion section of Chapter 5.

4.2 DESCRIPTION OF PARTICIPANTS

The interviews conducted were directed to 2 different groups of participants. These 2 groups include Participant Group A and Participant Group B. Participant Group A included IT decision-makers working in a commercial bank in SA. Participants in this group were all employed by a South African commercial banking institution and had previously contributed to an IT decision in their organisation. Participant Group B included blockchain experts within the SA context. Each of these participant groups are presented in Section 4.2.1 and Section 4.2.2 respectively.

4.2.1 Participant Group A

A total of 5 participants constituted Group A. All participants in Group A held different positions from middle to senior level in their organisations. The names of participants in Group A as well as their respective organisation names were withheld on the premise of anonymity. Table 4 below presents the 5 participants from Group A who were interviewed for the preparation of the data analysis. Their roles, responsibilities and years of experience in IT are provided to establish the relevance of their participation in accordance with the research objectives of this study. Each participant is employed at a different commercial bank in SA, improving the rigour of the research. Additionally, to ensure further triangulation, data was collected from employees who possessed different IT decision-making roles.

Table 4: Research Participant Group A Demographics

Research Participant: Blockchain Experts	***Role***	***Qualification***	***Experience in SA Banking Environment***
PA1	Head of Blockchain	• Bachelor's Degree: Actuarial Science	11 Years
PA2	Head of Payments	• MBA (Electro-Mechanical Engineering) • Postgraduate Degree: Computer Science	10 Years
PA3	Head of Technology Platforms	• Postgraduate Degree: Computer Science	13 Years
PA4	Senior System Analyst	• Postgraduate Degree: Computer Science	4 Years
PA5	Head of IT	• Postgraduate Degree in Actuarial Science	9 Years

PA1:

Participant A1 holds the position as the head of the blockchain and cryptocurrency department in a leading commercial bank in SA. His roles include formulating and managing a blockchain team, finding and researching business cases for blockchain in the SA banking environment and formulating blockchain solutions for these business cases. He has been in this position for 1 year and was previously the head of retail foreign exchange in the same commercial bank. Additionally, he possesses a Bachelor's Degree in Actuarial Science and 11 years of experience within the SA banking industry.

PA2:

Participant A2 holds the position as the head of payments in a commercial bank in SA. His role is primarily focused on domestic and cross-border payments, payment architecture

and the integration of payment solutions. Moreover, he possesses an MBA (Masters in Business Administration) in Electro-Mechanical Engineering as well as a Postgraduate Degree in Artificial Intelligence. Additionally, he has 10 years of experience within the SA banking industry.

PA3:

Participant A3 holds the position as the head of technology platforms at a leading commercial bank in SA. His roles are focused on planning, delivering and engineering the technology underpinning the system platforms of the bank. His skills are specialised in IT security, artificial intelligence, machine learning, software development and network management. He previously worked for 4 years as the senior information security specialist at the same bank. Moreover, he possesses a Postgraduate Degree in Computer Science. Additionally, he has 13 years of experience within the SA banking industry.

PA4:

Participant A4 holds the position of a senior system analyst at a commercial bank in SA. His role includes managing IT projects, leading documentation of detailed business requirements for systems and participating in the design, development, analysis and testing of systems or business changes. Moreover, he possesses a Post-Graduate Degree in Computer Science. Additionally, he has 8 years of experience as a Systems Analyst, of which 4 years are in a banking environment.

PA5:

Participant A5 holds the position as a head of IT at a leading commercial bank in SA, specifically leading the app and website of the bank. His roles include managing a team and finding innovative ways to improve the app and website of the bank. Moreover, he possesses a Postgraduate Degree in Actuarial Science. In addition to this, he has 9 years of experience in the SA banking industry.

4.2.2 Participant Group B

Participant Group B included blockchain experts from SA. Participants in this group all possessed specified blockchain knowledge and held blockchain experience. Table 5 below depicts the 4 participants from Group B who were interviewed for the preparation of the data analysis. Their roles, experience with blockchain technology and other key points are

also presented to establish the relevance of their participation in accordance with the research objectives of this study. From the 4 participants, 2 are CEOs, 1 is a blockchain consultant and 1 is a software engineering manager. Moreover, all participants in Group B have a minimum of 5 years' experience in the blockchain environment, with a maximum of 8 years' experience. Each participant possesses either a bachelor, postgraduate or master's degree relating to their field. Many of the participants possess more than 1 degree. Participants of Group B also provided consent to use their names and respective organisation names.

Table 5: Research Participant Group B Demographics

Research Participant: IT Decision-Makers	***Role***	***Qualification***	***Experience in Blockchain Environment***
PB1	Director/CEO	• Postgraduate Degree: Finance • Bachelor's Degree: Finance • Bachelor's Degree: Economics	7 Years
PB2	Blockchain Consultant	• Postgraduate Degree: Computer Science	5 Years
PB3	CEO	• Bachelor's Degree: Finance • Bachelor's Degree: Financial Technology	8 Years
PB4	Software Engineering Manager	• Master of Business Administration (MBA) • Bachelor's degree: Computer Science	6 Years

Participant B1:

Participant B1 is the director of a blockchain company specialising in Non-Fungible-Tokens (NFTs), called Curate. The company is a marketplace for NFTs and functions as an application connected to the blockchain network. PB1 developed, designed and implemented the payment flow for the Curate application, which possesses blockchain agnostic capabilities. Moreover, he possesses 7 years of experience in the blockchain technology environment, where he previously worked as a blockchain consultant for a blockchain mining company in the UK. Additionally, he possesses 2 Bachelor's Degrees in Finance and Economics and a Postgraduate Degree in Finance.

Participant B2:

Participant B2 is a blockchain consultant at a public SA business consulting firm. The participant specialises in consultation to help businesses develop and implement key blockchain strategies to optimise business efficiency. Moreover, PB2 also analyses existing blockchain applications and creates strategies to improve them. In addition to this, an important aspect of his role is to stay updated on blockchain technology. Participant B2 possesses a Post-graduate Degree in Computer Science and has 5 years of experience in the blockchain technology environment.

Participant B3:

Participant B3 is the CEO of a blockchain based real-estate company which specialises in collective purchase of property through cryptocurrency, called Crowdprop. The participant developed the business and now manages it with his partners. The company allows the purchase of a fraction of a property by multiple owners, through payment of specific cryptocurrencies. In addition to this, Participant B3 possesses two Bachelor's Degrees in Finance and Financial Technology. Moreover, he has 8 years of experience in the blockchain environment.

Participant B4:

Participant B4 holds the position of a software engineering manager at a leading blockchain-based cryptocurrency trading platform in SA. He is responsible for managing and leading a team to design and improve the company's trading platform and systems. Participant B4 also possesses a Masters of Business Administration and a Bachelor's Degree in Computer Science. In addition to this, he has 6 years of professional experience in the blockchain environment.

Figure 10 below depicts the demographics of both participant groups into a single visual. It represents the vastness between the IT decision-makers and blockchain expert participants in terms of their roles and years of experience in their specific environments. The role demography entails blockchain experts and IT decision-makers who fulfill various roles within the blockchain environment and SA banking industry respectively. The roles for blockchain experts included 1 software engineering manager, 1 blockchain consultant

and 2 CEOs. The roles for IT decision-makers included 1 senior business analyst, 1 head of IT, 1 head of technology platforms, 1 head of payments and 1 head of blockchain within a SA bank. Each of the blockchain experts within these roles possessed experience within the blockchain environment ranging from 5 to 8 years, whereas each of the IT decision-makers within these roles possessed experience within the SA banking industry ranging from 4 to 11 years.

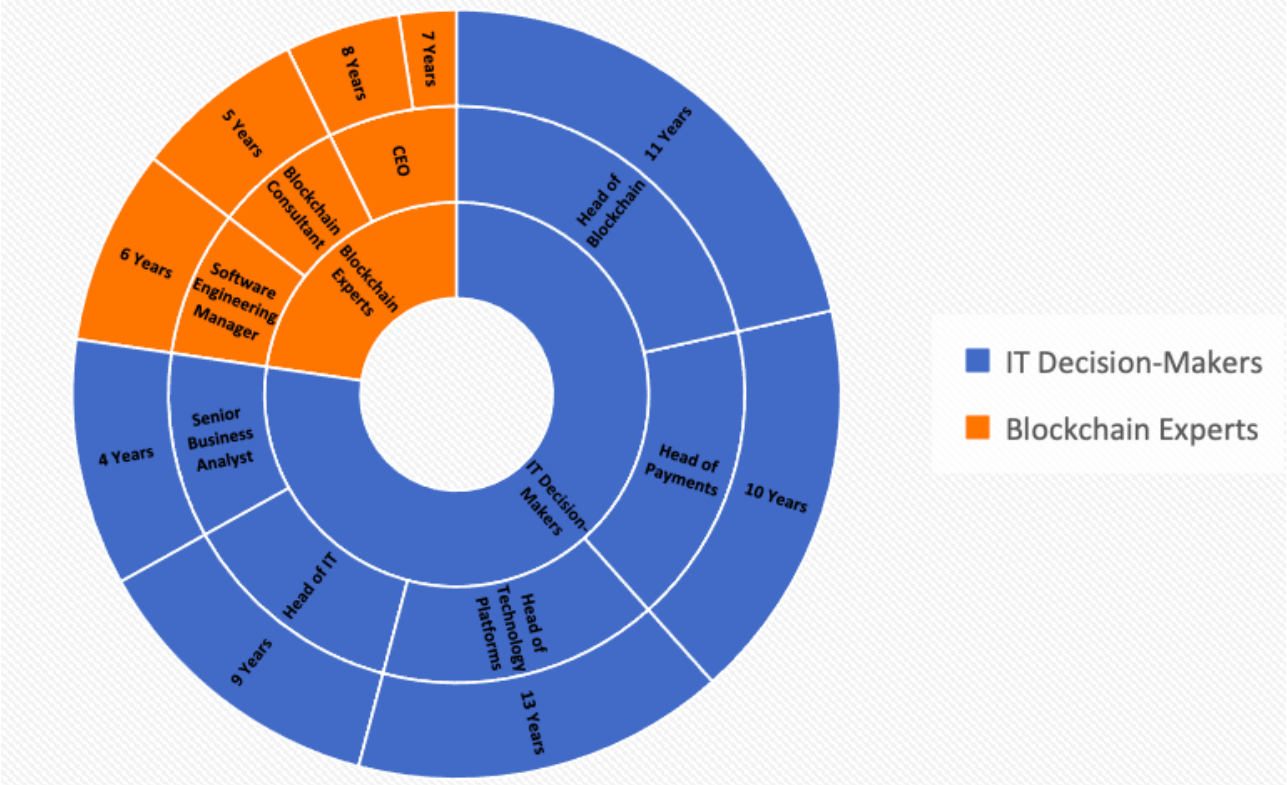

Figure 10: Demographics of Participant Group A and Participant Group B

4.3 INTERVIEW GUIDE PILLAR RESPONSES

The following sections encapsulate the responses coached by the interview guide pillars explained in the research design of Section 3.5. Each pillar provides the respective responses of questions posed to participants from each group.

4.3.1 Introductory Interview Guide Pillar

The first pillar encapsulates questions which introduce the participants and their relative roles and experience. This pillar provides a deeper insight into the credibility of participants for the objectives of the study.

The first question from Participant Group A and first 2 questions from Participant Group B were posed to introduce the participants and determine their level of expertise in the blockchain field. These questions were phrased in accordance with the criteria that each group participant occupied, as stipulated in Section 3.2.

Participants from Participant Group A were asked to provide information on their experience with IT adoption and blockchain technology, whereas participants from Participant Group B were asked to provide information on their experience with blockchain technology. Additionally, participants from Group B were also asked whether they had any published blockchain projects and if they answered yes, they were asked to provide information on their published blockchain project. The specified questions and results of these questions are presented below: Additionally, a summary of participants' roles and experience was stipulated in Tables 4 and 5 above.

The following question was asked to determine the background and experience of the IT decision-makers of Participant Group A:

Can you please provide information on your experience with IT adoption and/or blockchain technology?

Participants of Group A were all involved in 1 or more IT adoption projects within a commercial bank in SA. From these participants, 1 specialises in blockchain technology in banking, 1 specialises in payments of banks, 1 specialises in IT of banks, 1 specialises in platforms of banks, and finally 1 specialises in systems of banks. The information regarding the IT adoption experience of participants from Group A were presented in Section 4.2.2.

The following question was asked to determine the experience relating to blockchain or financial technology possessed by the blockchain experts of Participant Group B:

What is your experience with blockchain or financial technology?

Participants from Group B occupied diverse roles in the blockchain and financial technology industry. From the 4 participants, 2 were CEOs of blockchain-based

companies, 1 was a software engineering manager at a leading SA blockchain-based cryptocurrency trading company, and 1 was a blockchain consultant at a SA business consulting firm. Each participant had a strong tie to blockchain and financial technology. The roles and responsibilities for each participant and their respective profiles were noted in Section 4.2.2. Additionally, a summary of the participants from Participant Group B was presented in Table 5.

The following question was asked to determine whether the blockchain experts from participant group B had published any blockchain-related projects:

Do you have any blockchain related projects published?

Two out of the 4 participants from Participant Group B have had a blockchain project published. PB1 and PB3 both answered positively to this question, whereas PB2 and PB4 answered negatively.

If the participants had a published blockchain project, more information was gathered on the project by asking the following question:

Can you please provide more information on the project?

Participant PB1 published a blockchain project which is a NFT marketplace application, allowing users to trade NFTs for various types of cryptocurrencies such as Ethereum and his own cryptocurrency, Curate. Additionally, PB3 published a crowdfunding blockchain-based project which allows users to crowdfund and own property by collectively paying with specific cryptocurrencies.

4.3.2 Value Interview Guide Pillar

The value pillar refers to the importance which blockchain technology can render for commercial banks in SA if it is adopted within their organisations. It encompasses the enablers for blockchain adoption by SA commercial banks. The questions posed in this pillar encapsulate what the participants found to be important for the organisation and

stakeholders of the organisation in the event of blockchain adoption. The responses received within this pillar pave the way forward in answering SRQ1.

The following question was asked to gain an understanding from an internal and external perspective of a commercial bank in SA on the potential benefits of blockchain technology in the South African banking industry:

In your opinion, what benefits do you think blockchain technology could have on South African commercial banks if it is adopted within your organisation?

The question was posed to gain insight into the potential use and value of blockchain technology for the South African commercial banking industry. The question was posed to 2 different participant groups. Moreover, the question was posed to both participant groups to gain diverse insight from an internal and external perspective. The internal perspective encompasses the opinions of IT decision-makers employed within a South African commercial bank, whereas the external perspective encapsulates the opinion of an expert of blockchain which meets the set standard stipulated in Table 1 of Section 3.3.1. A total of 9 participants answered the question, where 5 included IT decision-makers and 4 included blockchain experts. The results found that smart contracts, interbank blockchain collaboration and new banking services were all benefits of blockchain adoption by SA commercial banks.

4.3.2.1 Smart contracts

A total of 7 out of 9 participants made mention of **smart contracts** as a core benefit for blockchain adoption by commercial banks in SA. These 7 participants agreed that there are many opportunities which South African commercial banks can seize through leveraging smart contracts within their organisations. From these 7 participants, 3 were IT decision-makers from Participant Group A and 4 were blockchain experts from Participant Group B. All participants from Group B mentioned smart contracts as an enabler to blockchain adoption. Moreover, PA2 explained that by implementing a smart contacts system, it opens many doors of opportunity for the banking industry, in that it allows the bank to codify and therefore self-execute their own terms and conditions within various sectors in the organisation. PB2 also indicated that smart contracts are *“enablers to endless opportunities for banks through their predetermined terms and conditions.”*

The participants mentioned that the implementation of smart contracts is a predecessor for banks to lower costs, improve transaction speeds and to make provision for self-executing loans, which had emerged as our key considerations during the thematic analysis.

According to the participants, smart contracts could lower the costs of the business in different avenues. A total of 5 out of 9 participants mentioned lowering of costs through smart contracts. Out of these 5 participants, 3 were blockchain experts and 2 were IT decision-makers. Participant PA2 mentioned that the implementation of a smart contract will lower the costs of manual labour through automation. Moreover, he added that administrative costs will also be lowered through automation.

> *PA2: "Banks could implement a well written smart contract to verify the credit score and admissibility of a client to determine their loan amount eligibility; this would save high amounts of manual administrative costs to the organisation because the process would be automated."*

In accordance with this, a participant who is a blockchain expert, indicated that human error would be highly minimised through using smart contracts, resulting in reduced human error costs to the organisation.

> *PB2: "…because of smart contracts' self-executing properties, a well-defined smart contract from the start will ensure continued efficiency and no potential human error, as it will be clearly defined from the start."*

In addition to this, PA3 mentioned that smart contracts could surely lower the costs in a banking organisation, however, he was concerned that the implementation of a smart contract system would be too costly and take a vast amount of time to recoup the implementation cost.

Moreover, another finding was that smart contracts enable improved transaction speed. A total of 3 participants mentioned improved transaction speed as a result of smart contract implementation. One of the participants was an IT decision-maker from Group A and 2 of the participants were blockchain experts from Group B. PB1 explained that smart

contracts' self-executing properties allow for transactions to execute faster. In addition to this, PB4 indicated that smart contracts allow for increased efficiency in clearing of payment transactions due to the pre-determined conditions which smart contracts cater for. These findings were also supported by PA1, an IT decision-maker, who explained that smart contracts make provision for real-time international transactions.

> *PB4: "…clearing houses of payments are more efficient because every condition can be tailored during the creation of the smart contract."*

> *PA2: "…smart contracts allow real-time international transactions, there is no longer a need for waiting several days for clearing."*

A small number of those interviewed indicated that smart contracts may enable loan processes in commercial banks in SA. Two out of the 9 participants indicated that smart contract loans are an enabler for blockchain adoption in the SA banking industry. Both of these participants were blockchain experts from Participant Group B. PB2 mentioned that smart contract loans are not dependent on manual processing and can self-validate client eligibility for a loan. Additionally, PB2 indicated that smart contracts use well-defined terms and conditions, and these conditions can be utilised for lending in a bank. It is also important to note that no participants from Participant Group A made mention of smart contract loans.

> *PB4: "Smart contracts are independent and could validate client loan eligibility and also create an automated loan service using if, when and then statement conditions."*

> *PB2: "…smart contracts provide very well-defined terms and conditions for lending in a banking environment."*

4.3.2.2 New Banking Services

Our results found that blockchain technology makes provision for banks to improve current and create new banking services. A total of 5 out of 9 participants have mentioned that blockchain technology facilitates the creation of **new banking services**. Out of these 5

participants, 4 participants were considered blockchain experts and 1 participant was employed in a SA commercial bank. The results found 2 key considerations for new banking services. These include metaverse banking services and cryptocurrency investing.

A total of 3 participants mentioned a metaverse banking service as a potential benefit for blockchain adoption in South African banks. These participants were all blockchain experts from Participant Group B. Participants from Participant Group A made no mention of metaverse banking or the metaverse in its entirety. One of the blockchain experts provided an explanation of what metaverse banking entails:

> *PB4: "Metaverse banking includes a blockchain and augmented reality-based application or platform which allows clients to access banking services remotely, while still achieving an in-store presence."*

Moreover, PB1 indicated that banks could leverage virtual reality and create new banking services through a metaverse platform. In addition to this, 2 participants mentioned that metaverse banking is not fully developed yet and may take years before it is fully implemented. For instance, 1 participant mentioned that the metaverse will take time to reach its full potential, however, still holds a competitive advantage to banks who leverage it early.

> *PB4: "It may take some time before it is fully developed, but banks can gain that competitive edge by creating their own."*

The participant also mentioned the opportunity of competitive edge for banks in SA. Although metaverse banking may take time before it is fully developed, PB4 mentioned that banks may leverage the idea of metaverse banking and create their own metaverse platform or application.

Additionally, our results found that banks could improve their financial services by offering cryptocurrency investing opportunities. A total of 2 out of 9 participants made mention of cryptocurrency investing as an enabler for blockchain adoption in the SA commercial banking industry. From these 2 participants, both were blockchain experts from Participant

Group B. PB3 mentioned that banks could facilitate trading of specific cryptocurrencies as a form of investment, as with that of other commodities.

> *PB3: "Banks could introduce trade of commodity like cryptocurrencies such as Bitcoin, the same way that gold and stocks are traded."*

In addition to this, it was mentioned by PB2 that banks can increase their service offerings by facilitating the trade of cryptocurrencies for clients. PB2 indicated that it will also improve commercial banks' financial instruments to the public.

4.3.2.3 Interbank Blockchain Collaboration

Additionally, our results found that blockchain technology enables interbank collaboration. A total of 4 participants made mention of **interbank blockchain collaboration** as an enabler for blockchain adoption for the SA commercial banking industry. From these 4 participants, 3 of them were IT decision-makers from Participant Group A and 1 of them was a blockchain expert from Participant Group B. These participants made specific mention of key considerations of interbank blockchain collaboration, namely KYC documentation and payment settlements.

Moreover, it was found that blockchain technology can be used amongst commercial banks to simplify the process of KYC documentation. Two participants mentioned that **interbank KYC documentation** is an enabler for banks to adopt blockchain technology. Out of these 2 participants, 1 participant was a blockchain expert and 1 was an IT decision-maker employed within a SA commercial bank. PB1 indicated that blockchain allows for the collaboration of commercial banks through the implementation of a KYC system. In addition to this, 1 participant mentioned the efficiency of blockchain-based KYC documents for clients of other banks in the instance of opening a new bank account.

> *PA2: "KYC on the blockchain will make it more efficient for all commercial banks and clients when creating a new banking account."*

The results also found that blockchain-based **interbank payment settlements** through bank collaboration was an enabler for blockchain adoption by SA commercial banks. Two participants mentioned payment settlements as an enabler, both of whom were IT

decision-makers from Participant Group A. Both participants indicated that blockchain payment settlements amongst banks are instantaneous and have no settlement times. In addition to this, 1 participant mentioned that the type of blockchain used amongst banks is important in terms of security. He explained that a consortium of blockchains created between banks ensures traceability.

> *PA1: "…consortium blockchains ensure interbank payment settlements are secure yet traceable."*

Moreover, it was also found that interbank collaboration may reduce or eliminate fees amongst banks. Participant PA2 mentioned that interbank payment settlements will "*significantly reduce the amount of transactional fees for both clients and banks*".

A total of 3 emerging themes and 8 key considerations were identified. Table 6 summarises the emerging themes and key considerations identified in this pillar.

Table 6: Emerging Themes Value Pillar

Emerging Themes	***Key Considerations***
1. *Smart Contract Perceived Benefits*	1. Lower Costs 2. Faster Transactional Speed 3. Smart Contact Loans 4. Metaverse Banking 5. Cryptocurrency Investing 6. Asset Management 7. Interbank KYC Documentation 8. Interbank Payment Settlements
2. *New and Improved Blockchain Banking Services*	
3. *Interbank Blockchain Collaboration*	

4.3.3 Technological Interview Guide Pillar

The following questions were asked to participants to gain an understanding of the technological challenges for blockchain adoption for commercial banks in SA. This pillar encompasses challenges specifically related to blockchain as a technology and the related

factors associated with it. The questions were framed through a lens of the technological element of the TOE framework identified in Section 2.5.

The following question was asked to gain a better understanding of the reasons that the participants believe that their organisations are prepared or unprepared for adopting blockchain technology:

Do you think your organisation is technologically ready for the adoption of blockchain technology? Can you please explain why or why not?

All 5 participants answered that they believe that their organisations are not yet ready to adopt blockchain technology completely. The insights received from participants were vast and each participant provided various reasons why they believe that their organisation is not yet ready for blockchain adoption. PA3 stated that his organisation was in the process of adopting blockchain, however, they are still far from ready.

A consistent finding was that the **complexity of blockchain technology** was a hindrance to blockchain adoption in the SA commercial banking industry. Four out of the 5 participants insinuated that blockchain technology is complex in nature. For example, PA2 stated that *"blockchain is a new technology with intricate, evolving elements that experts are still finding solutions around. One of these elements from a banking perspective is the issue of scalability".*

Moreover, another finding was that the lack of a dedicated blockchain team was hindering the adoption of blockchain adoption in participants' organisations. Three participants mentioned the lack of blockchain human capital as an issue in accelerating blockchain adoption. For instance, PA1 stated that his organisation was still required to build in-house capabilities before blockchain can be adopted in their organisation. Two participants mentioned that they still require the correct skills and human capital before they can move forward with any blockchain adoption. For example, PA4 mentioned that his organisation requires *"a team who are skilled in Solidity or a similar smart contract native language before we can even think of moving forward with any other blockchain projects."*

To determine any other possible technological challenges for the participant's organisation to adopt blockchain technology, the following question was asked:

Can you think of any other technological factors which may hinder the adoption of blockchain technology in your organisation?

All 5 participants revealed at least 1 additional challenge hindering blockchain adoption in their organisations. Interoperability was a key challenge mentioned by 3 out of the 5 participants. Participants suggested that integrating a blockchain system with their current financial system and database is a significant task. PA5, who is a head of IT in a South African commercial bank, mentioned that incorporating the organisation's legacy system's current data into a blockchain based system is the *"most complex challenge for adopting blockchain".* PA5 believed that data interoperability was an issue for integration of blockchain into the organisation's existing legacy system. Participant PA3 mentioned that the integration of the organisation's data into a blockchain system will require *"high-levelled skills, time and facilities from the organisation."*

In addition to this, incorporating different legacy systems from external entities such as government, relative commercial banks and the Reserve Bank was also suggested as a challenge of interoperability for banks to adopt blockchain technology by one of the participants:

> *PA1: "…banks would also require collaboration of data from other entities such as the government and the South African Reserve Bank to fully adopt aspects of blockchain, and this will take time to facilitate."*

In addition to the challenge of interoperability, 4 out of 5 participants mentioned scalability as a potential challenge for adopting blockchain in their organisations. Two participants elucidated that traditional proof-of-work blockchain mechanisms do not cater for large volumes of simultaneous transactions to occur without the use of high computational power. Participant PA2 was concerned about the robustness of blockchain to anticipate an increasingly high number of transactions within a banking environment.

PA2: "…the proof-of-work mechanism will eventually become problematic for a bank like ours in terms of the number of transactions that occur per second between the stakeholders in the facility."

Participant PA5 also mentioned scalability as an issue for blockchain adoption in the banking industry, by commenting that *"scaling transactions on a blockchain solution is problematic because validation of each blockchain node will require an exorbitant number of validators."*

However, another participant revealed that although scalability is a current challenge, public blockchains are prioritising resolving the challenge and finding solutions. PA4 mentioned that a public blockchain is currently looking for solutions to move blockchain mechanisms for large amounts of transactions.

PA4: "Ethereum is working on a solution to move from Proof-of-Work to Proof-of-Stake, which will ultimately allow a much larger number of transactions on the blockchain at one time."

The emerging themes and key considerations from the technological pillar which were identified by the participant responses are summarised in Table 7 below:

Table 7: Emerging Themes Technological Pillar

Emerging Themes	***Key Considerations***
1. Blockchain Complexity	*1. Smart Contract Coding* *2. Scalability* *3. Interoperability*

In the technological pillar of this section, our results revealed that blockchain complexity was a technological challenge for blockchain adoption by SA commercial banks. Three key considerations were identified through the complexity of blockchain, these being (1) smart contract coding, (2) scalability and (3) interoperability.

4.3.4 Organisational Interview Guide Pillar

The following questions were posed to participants to gain an understanding of the organisational challenges for blockchain adoption for commercial banks in SA. This pillar

specifically encapsulates factors relating to blockchain adoption from an organisational viewpoint. The questions were framed through a lens of the organisational element of the TOE framework identified in Section 2.6. Although questions were framed for the organisational element, emerging non-organisational themes were also identified through different participant answers.

Participants were asked the following question to determine the level of awareness of blockchain technology amongst senior management and other IT decision-makers in the organisation:

How aware of the adoption of blockchain technology are senior management and other IT decision-makers in your organisation?

The awareness of the technology plays an important role in understanding the magnitude of challenges for adopting blockchain technology within the South African banking industry. Participants all provided insight into the level of awareness of senior management for blockchain technology. All participants indicated that all of the senior management in the organisation have at minimum heard about blockchain technology. Participant PA4 stated that senior management are becoming increasingly aware of the potential of blockchain.

Two out of the 5 participants indicated that many of the senior management members in the organisation associate blockchain technology solely with the trading of cryptocurrencies. PA3 and PA5 both indicated that senior management are unaware of the full potential of blockchain technology:

> *PA3: "…as they mostly view blockchain as Bitcoin and buying or selling of cryptocurrency."*

> *PA5: "…I believe their understanding of blockchain is not the actual potential of blockchain's technology, but more of their understanding of Bitcoin and Ethereum."*

Participants also declared that the negative associations which come with blockchain technology have resulted in the adoption of blockchain being delayed. One participant

mentioned that the negative associations which come with blockchain had previously caused senior management to halt all blockchain related projects and research. The participant identified that a dedicated research team and allocated research budget are both important factors for blockchain adoption in the SA banking industry.

> *PA1: "...the negative associations of blockchain such as the volatility of cryptocurrencies, have caused us to not build the in-house competencies such as a dedicated research team and allocated budget to pursue blockchain projects."*

Moreover, PA2 stated that their organisation is associated with a blockchain consortium dedicated to blockchain research for business cases within banks. The participant indicated that senior management in his organisation is becoming increasingly aware of the potential of blockchain due to the associated consortium.

The following question was asked to determine whether the support of top management in the organisations of participants is considered important, specifically for blockchain adoption:

In your opinion, is the support of top management within your organisation considered an important factor for the decision to adopt blockchain technology?

The question was posed to gain a deeper insight into the potential adoption challenges for blockchain by senior management of the banking organisations. All 5 participants answered that **top management support** is an important factor for adopting blockchain technology in their organisations. Some participants further explained the reasons for which they believe blockchain has not been fully adopted by their organisations, in relation to top management. According to PA5, blockchain awareness was seen to be minimal and bias existed in top management's personal understanding of blockchain. A total of 3 participants mentioned that negative associations with blockchain technology is a result of delay in blockchain adoption in their organisations.

> *PA5: "...external factors such as volatility of cryptocurrencies has caused an uncertain appreciation for the technology as a whole."*

PA1: "...because blockchain is such a new and complex technology, I believe many senior managers know only what the media has shown them in terms of blockchain."

Two of the participants, PA1 and PA4, also mentioned that an allocated budget is an important factor for blockchain adoption in the organisation. PA4 stated that top management play an important role in liaising on the budget agreement for blockchain research and potential projects. PA1 mentioned that the budget for blockchain research and projects was an issue in the organisation due to the lack of resources and in-house competencies of the organisation.

PA1: "…another point when it comes to the budget, is that it is uncertain as we need to build our blockchain related competencies from scratch, which means we have a lot of catching up to do."

To determine any other possible organisational challenges for the participant's organisation to adopt blockchain technology, the following question was asked:

Can you think of any other organisational factors which may hinder the adoption of blockchain technology within your organisation?

The question was answered by all 5 participants, of whom 3 indicated that for the adoption of blockchain technology between commercial banks to occur, trust is a significant concern. Moreover, the concept of 'Inter-Organisational" challenges emerged through participants responses to this question. For example, Participant PA2 mentioned that *"there needs to be a strong relationship of trust between all banks in SA if we want to achieve an interbank blockchain solution."*

Another concern for interbank blockchain adoption was trust, specifically in relation to KYC documentation amongst banks. The concern was in relation to the KYC documentation blockchain enabler noted in the response to the blockchain enabler question above. Two out of the 5 participants mentioned KYC trust as a challenge for interbank blockchain adoption. PA3 mentioned that it would require either a strong KYC system amongst banks, or high levels of trust for a successful implementation and maintenance of blockchain-

based interbank KYC documentation. Moreover, PA5 commented that *"…there would need to be some standard to prevent banks from poaching each other's clients through the transparent KYC documents on the blockchain containing client information."*

In the addition to the above, a total of 2 of the 5 participants also indicated that it is required to have a dedicated research team within the organisation for blockchain technology before adoption can be achieved. For example, 1 of the participants mentioned the importance of blockchain research and a research team:

> *PA5: "...I believe that there is a lack of blockchain research within the organisation for a suitable blockchain use case; having the right research and blockchain team will significantly accelerate adoption."*

> *PA4: "…vigorous blockchain research is still required and having dedicated human capital and resources for this would surely help in achieving the correct blockchain solution."*

The emerging themes and key considerations from the organisational pillar which were identified through the participant responses are summarised in Table 8 below:

Table 8: Emerging Themes Organisational Pillar

Emerging Themes	***Key Considerations***
1. *Top Management Support*	1. *Blockchain Awareness*
2. *Organisational Readiness*	2. *Negative Associations*
3. *Interorganisational Trust*	3. *Blockchain Research Team*
	4. *Budget*
	5. *KYC Documentation Trust*

The support of top management, organisational readiness and interorganisational trust were found to be emergent factors for blockchain adoption. The key considerations categorised as challenges of blockchain adoption were identified as blockchain awareness, negative associations, a blockchain research team, budget and KYC documentation trust.

4.3.5 Environmental Interview Guide Pillar

The following questions were asked to participants to gain an understanding of the environmental challenges for blockchain adoption for commercial banks in SA. This pillar specifically encapsulates factors relating to blockchain adoption from an external, non-organisational viewpoint. The questions were framed through a lens of the environmental element of the TOE framework identified in Section 2.6.

The following question was asked to determine whether the regulatory environment will have an impact on blockchain adoption in the participant's organisation:

Do you think the regulatory environment may have an impact on the adoption of blockchain technology within your organisation?

All 5 participants responded positively to this question and believed that the regulatory environment would have an impact on blockchain adoption in their organisations.

The following question was asked to further determine how the regulatory environment would have an impact on blockchain adoption in the participant's organisation:

Can you please explain why?

All 5 participants unanimously stated that the uncertainty around blockchain regulation was the most significant reason for why the regulatory environment will impact the adoption of blockchain technology in their organisations. PA1 mentioned that the current state of regulation is underpinned by *"traditional centralised models of security processing".* The participant was concerned that the cooperation of all related entities would take years before there is a migration of a decentralised regulatory framework.

In addition to this, PA2 indicated that he believed that the blockchain regulation by the SA government would only be implemented once other developed countries have implemented blockchain regulations. Moreover, another participant mentioned that the government has not prioritised blockchain technology regulations because cryptocurrencies are new and intricate.

> *PA4: "...cryptocurrency asset classes are fairly new; governments have not given these asset classes prioritisation."*

In addition to the above, 3 participants also indicated that the support of the government of SA may be required in the instance of fraudulent blockchain transactions. Participants mentioned that a significant characteristic of blockchain technology includes irreversibility of transactions and indicated that support of the correct government officials will be necessary in terms of regulation in this instance.

> *PA5: "…a blockchain transaction is irreversible. What would happen if a high amount transaction was sent to the wrong person? The government would need to intervene in this case."*

The support of government officials was also raised as an issue by a participant in relation to the environmental concerns associated with blockchain technology. PA5 mentioned that blockchain technology's proof-of-work mechanism uses high computational power and due to this, the government would favour the environmental issues of blockchain instead of its potential use.

PA1 stated that the existing regulatory frameworks are underlined by centralised traditional models of security processing. PA1 believed that due to this, cross-jurisdiction cooperation will result in years of migration to a decentralised regulatory framework.

The following question was asked to determine whether the pressure from industry or competitors will influence participants' organisations to adopt blockchain technology:

In your opinion, will competitive pressure or industry pressure make an impact in the decision to adopt blockchain technology within your organisation? Why or why not?

The question was answered by all 5 participants, of whom 2 answered no and 3 answered yes. The participants who answered positively indicated that they always strived to achieve the competitive advantage within their organisations. Moreover, blockchain is a new

technology and it was noted by these participants that there was still a lot of potential for the organisation to obtain through blockchain. For example, one participant mentioned:

> *PA2: "….in terms of blockchain, banking organisations still have a lot to learn to fully benefit from it."*

The other 2 participants both provided the same reasons for not answering yes to the question. These participants believed that other larger banking corporations should first trial the adoption of blockchain technology, so that the potential challenges that come with any new technology adoption are known. For example, Participant PA5 maintained that *"...I think it would be smarter to first understand the teething issues faced by other banks, and then adapt and adopt the technology."*

No challenges emerged from the question, however, insight into the decision to adopt blockchain by the participants' organisations was observed.

To determine any other possible environmental challenges for the participants' organisations to adopt blockchain technology, the following question was asked:

Can you think of any other environmental factors which may hinder the adoption of blockchain technology within your organisation?

The question was answered by all participants, of whom 3 participants stated that they cannot think of any other environment factors which may hinder blockchain adoption within their organisations. The other 2 participants both indicated that blockchain transactions consume high amounts of energy. PA1, the head of blockchain at a leading commercial bank in SA, mentioned that the proof-of-work mechanism requires high volumes of computational power to mine a cryptocurrency, which in turn will use high volumes of energy.

> *PA1: "…mining a block on the chain will require computational power, whereas mining high volumes of transactions in a banking environment will require even higher volumes of computational power."*

Another participant, PA4, a senior system analyst at a leading commercial bank in SA, stated that although energy consumption seems to be a current environmental issue, there are solutions which will reduce the energy consumption of mining such as moving from proof-of-work to proof-of-stake.

Moreover, one surprising finding was the issue of privacy for interbank blockchain collaboration amongst banks. Three out of the 5 participants mentioned privacy as a challenge for blockchain adoption. PA5 contended that with interbank blockchain collaboration, data is visible to all participating banks. In addition to this, he was concerned with the conflicting data policies of the organisations in terms of the disclosing of data of all participating banks.

> *PA5: "…disclosing the bank's data can easily conflict with the organisations' data policies".*

In accordance with this result, PA3 mentioned that sharing of data amongst banks through blockchain transparency may result in "unethical temptation of poaching other banks' clients".

The emerging themes and key considerations from the environmental pillar which were identified through the participant responses are summarised in Table 9 below:

Table 9: Emerging Themes Environmental Pillar

Emerging Themes	***Key Considerations***
1. Regulatory Environment 2. Energy Consumption 3. Interbank Trust	1. Regulation Uncertainty 2. Government Support 3. Computational Power 4. Privacy

The regulatory environment, energy consumption and interbank trust emerged as the concerning challenges of blockchain adoption by SA banks for this pillar. In addition to this, regulation uncertainty and government support in terms of the regulatory environment; computational power in terms of energy consumption; and privacy in terms of interbank

trust, all emerged as key considerations to the challenges of blockchain adoption in the SA banking industry.

4.4 EMERGING THEMES

During the analysis of the interview responses, a total of 5 themes emerged. These themes include blockchain banking enablers, technological, organisational, environmental and interorganisational factors. From each of these themes, secondary themes and key considerations emerged. The primary themes and their respective secondary themes, key considerations and references are stipulated in Table 10. In addition to this, a high-level description of the findings of each theme is provided below. Chapter 5 discusses each primary theme, secondary theme and key consideration in detail.

Table 10: Thematic Analysis Themes and Key Considerations

Primary Theme	Secondary Theme	Key-Considerations	References
Blockchain Banking Enablers Context	New Banking Services	Metaverse Banking	**PB2, PB3**
		Cryptocurrency Investing	**PB2, PB3**
	Interbank Blockchain	KYC Documentation	**PA2, PA3, PA4**
		Payment Settlements	**PA1, PA3, PA2,**
Technological Context	Smart Contact Perceived Benefits	Lower Costs	**PA1, PA2, PA3, PB1, PB2, PB3, PB4**
		Improved Transactional Speed	**PA1, PB2, PB4**
	Blockchain Complexity	Scalability	**PA2, PA3, PA4, PA5**
		Interoperability	**PA1, PA3, PA5**
		Smart Contract	**PA1, PA3, PA4**

		Coding	
Organisational Context	Organisational Readiness	Blockchain Research Team	**PA4, PA5**
	Top Management Support	Blockchain Knowledge	**PA1, PA5**
		Blockchain Negative Associations	**PA1, PA3, PA5**
		Blockchain Budget	**PA1, PA4**
Environmental Context	Regulatory Environment	Government Support	**PA1, PA2, PA5**
		Regulation Uncertainty	**PA1, PA2, PA5**
	Energy Consumption	Computational Power	**PA1, PA5**
Interorganisational Context	Trust	KYC Documentation Trust*	**PA3, PA5**
		Privacy	**PA1, PA3, PA5**

4.4.1 Theme 1: Blockchain Banking Enablers

There are various enablers for the adoption of blockchain which were identified through the thematic analysis of participants' answers. Participants provided various answers to describe and outline the benefits of blockchain technology, which would encourage South African banks to adopt blockchain technology within their organisations. The blockchain banking enabler's theme emerged as a new fourth element to the TOE framework, as it could not be mapped to the traditional TOE elements.

The secondary themes and key considerations identified in the blockchain banking enabler context theme were considered as the primary motivations for blockchain adoption. Two secondary themes emerged from the thematic analysis from the primary theme of blockchain banking enablers: (1) new banking services and (2) interbank blockchain. From these 2 secondary themes, 5 key considerations were identified.

The key considerations of the blockchain banking enablers represent the specific enablers for adopting blockchain technology within a South African banking environment. The key considerations identified for the first secondary theme, new blockchain services, included asset management, metaverse banking and cryptocurrency investing. Lastly, the key considerations identified for the third secondary theme, interbank blockchain, included KYC documentation and payment settlements.

4.4.2 Theme 2: Technological Context

The second primary theme emerged as the technological element from the TOE framework. The technological theme represents the factors for adopting blockchain technology from a technical viewpoint, in terms of current challenges with or relating specifically to blockchain technology.

Moreover, 2 secondary themes were identified in the primary technological theme. The secondary theme included smart contract perceived benefits and blockchain complexity. Smart contract perceived benefits is an extension of the consideration of perceived benefits of the technological considerations proposed in Section 2.5.2 of Chapter 2. Smart contracts entailed 3 perceived benefits which made provision for the extension of the consideration. The perceived benefits of smart contracts included the potential value that smart contracts would render for organisations when adopting blockchain technology. The key considerations served as the perceived benefits of smart contracts and included lower costs and improved transactional speeds and smart contract loans. In addition to smart contract perceived benefits, the complexity of blockchain technology was also identified as a secondary theme through the analysis of the interviews conducted. Blockchain complexity includes the intricacy of the technology and the technological challenges it entails. The key considerations for blockchain technology represent the specific challenges of adopting blockchain technology within a South African banking industry. These

challenges of blockchain complexity were identified as smart contract coding, scalability and interoperability.

4.4.3 Theme 3: Organisational Context

The third primary theme emerged as the organisational element from the TOE framework. The organisational theme represents the factors influencing blockchain adoption, specifically within the banking organisation. The organisational secondary themes included (1) top management support and (2) organisational readiness.

Top management support entailed the level of awareness of blockchain technology by top management within the commercial banking industry. The key considerations were identified as blockchain awareness, negative associations of blockchain technology and an allocated blockchain budget. The level of awareness and negative associations of blockchain technology were both identified as predecessors for the support of top management.

The second secondary theme of organisational readiness required the anticipated readiness of the organisation in terms of resources. These resources were identified as key considerations in the thematic analysis. The only key consideration was identified as a dedicated blockchain research team in relation to blockchain adoption. This key consideration was identified as an important challenge hindering blockchain adoption by commercial banks in SA.

4.4.4 Theme 4: Environmental Context

The fourth theme emerged as the environmental element of the TOE framework. It encompasses the external factors impacting blockchain adoption in the South African banking industry. From the environmental theme, 2 secondary themes emerged. These secondary themes were identified as (1) regulatory environment and (2) energy consumption. These 2 secondary themes were considered as important factors hindering the adoption of blockchain technology in the South African banking industry. The key considerations for these secondary themes represent the specific challenges faced by commercial banks in SA for blockchain adoption. For the first secondary theme, regulatory environment, the support of government and regulation uncertainty were identified as

associating challenges. For the second secondary theme, energy consumption - the computational power to be used by banks - was considered as an associated challenge to adoption.

4.4.5 Theme 5: Interorganisational Context

In addition to the traditional structure of the TOE framework, a fifth element was identified during the thematic analysis. The considerations identified for organisation-to-organisation could not be mapped within the traditional TOE framework elements, hence an inter-organisational construct was included to extend the TOE framework and categorise the interbank key considerations. The interorganisational theme represents the factors and actions between commercial banks. The secondary theme of trust emerged during the thematic analysis. The trust between banks was considered as an important factor in the adoption of blockchain technology within the South African banking industry. The key considerations identified represent the specific challenges of interbank trust for adopting blockchain technology in the South African banking industry. These challenges of trust include KYC documentation trust and privacy.

4.5 CONCLUSION

The purpose of this chapter was to present and analyse the findings of the data from the 9 interviews conducted. Five interview pillars (described in Section 3.5) were used to guide the results and analysis of data: introductory, value, technological, organisational and environmental.

The introductory pillar was used to introduce the participants through their responses to the introductory questions posed to them during the interviews process. The value pillar was used to gather information on the expected value and benefits of blockchain technology for SA commercial banks. The last three pillars, namely technological, organisational and environmental, were used to gather information on the technological, organisational and environmental challenges of blockchain adoption for SA commercial banks respectively.

The findings of the expected value from the value pillar were found to be smart contract perceived benefits, new banking services and interbank blockchain collaboration. The key considerations identified for the value pillar included lower costs, faster transactional speed, smart contract loans, metaverse banking, cryptocurrency investing, asset management, interbank KYC documentation and interbank payment settlements.

The findings of the challenges for the technological pillar included blockchain complexity. The key considerations of the technological pillar included smart contract coding, scalability and interoperability. The findings of the challenges for the organisational pillar included top management support, organisational readiness and interorganisational trust. The key considerations identified for the organisational pillar included blockchain awareness, negative associations of blockchain, blockchain research teams, budget and KYC documentation trust. Finally, the findings of the challenges for the environmental pillar included regulatory environment, energy consumption and interbank trust. The key considerations identified for the environmental pillar included regulation uncertainty, government support, computational power and privacy.

From these findings, 5 major themes emerged, which are described in Section 4.4. These five themes included blockchain banking enablers, technological context, organisational context, environmental context and interorganisational context.

PART V – CONTRIBUTION

Part V consists of Chapter 5 and entails the contribution of the study. It presents the contribution in the form of a discussion of the findings of the study. Figure 11 depicts the progress of the study.

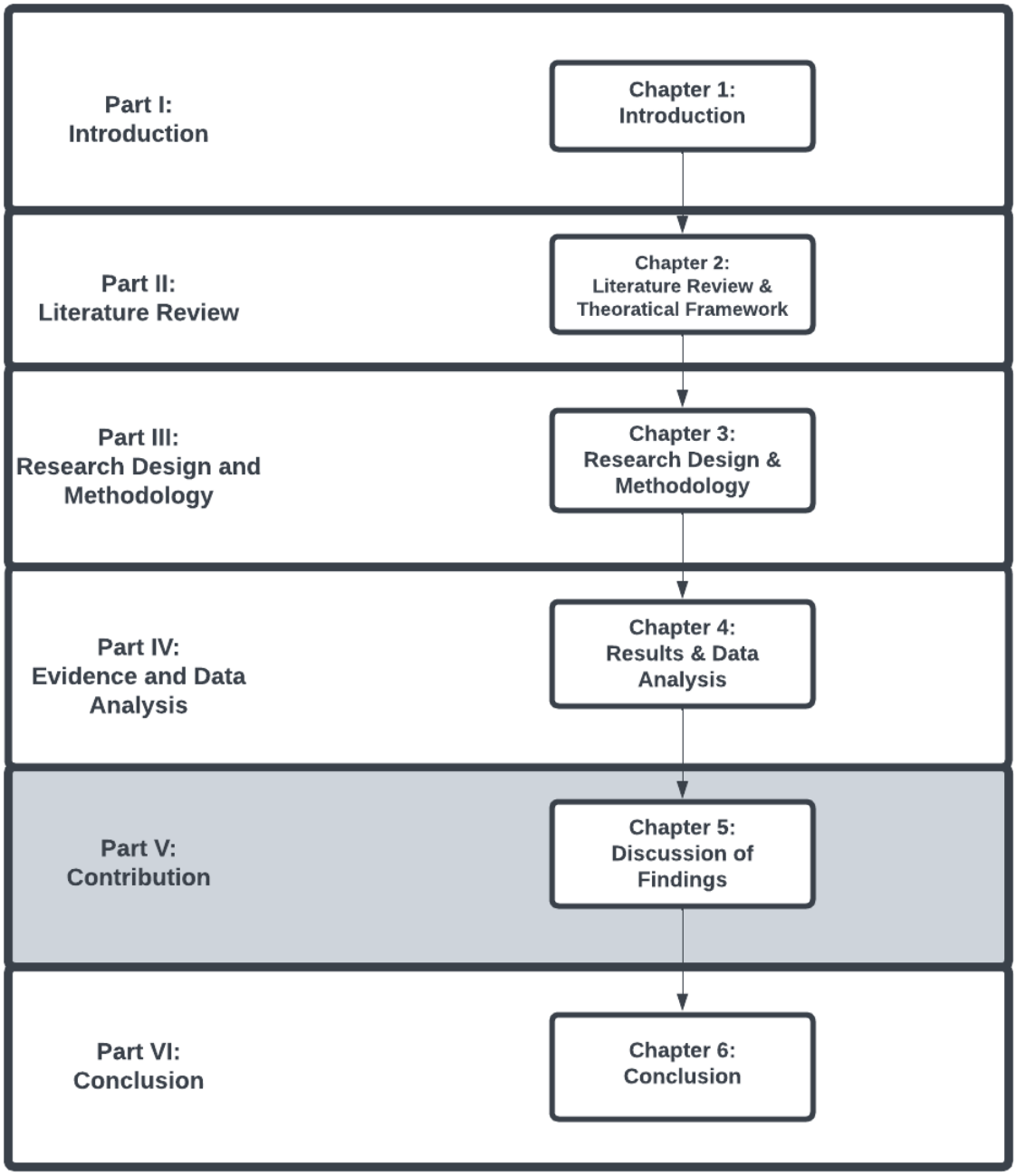

Figure 11: Part V – Contribution

5 DISCUSSION OF FINDINGS

5.1 INTRODUCTION

This chapter conveys the meaning of the data analysis outlined in Chapter 4. The main research objectives of this study are achieved in this chapter through answering each of the research questions. Section 5.2 discusses the expected value for blockchain technology adoption by SA commercial banks in the context of the research participants and existing literature from Chapter 3, in line with SRQ1. The following sections, Section 5.3 - 5.7 further discuss the challenges of blockchain adoption by SA commercial banks, in line with SRQ2. These challenges are discussed from technological, organisational, environmental and interorganisational perspectives. Finally, Section 5.8 presents and discusses the categorisation framework of this study in line with SRQ3.

5.2 INFLUENTIAL FACTORS OF BLOCKCHAIN ADOPTION BY SA BANKS

The main research question is made up by answering the sub-research questions. Each sub-research question is answered through the discussion of the themes which emerged during our thematic analysis.

This study aimed to develop a categorisation framework classifying the technological, organisational and environmental factors influencing the adoption of blockchain technology within the South African banking industry. The TOE framework was used as a lens throughout the research study to assist in the formulation of the interview questions and the analysis of the data. The study also aimed to identify any new blockchain adoption factors emerging through the TOE framework. Five themes emerged which highlighted the key considerations for blockchain adoption by South African commercial banks. These themes include blockchain banking enablers, technological context, organisational context, environmental context and interorganisational context. Table 11 depicts the TOE elements identified for each primary theme, secondary theme and key considerations identified during the thematic analysis. The elements highlighted were found to be new elements as an extension of the TOE framework. The highlighted elements in the TOE element column represent the new elements of the TOE framework which emerged in this study. Two new elements were identified, namely (1) blockchain enablers and (2) interorganisational.

These two elements as well as the other TOE elements are further discussed along with their secondary themes and key considerations in the following Sections 5.3 - 5.5.

Table 11: Research Findings from TOE Elements

TOE ELEMENT	Primary Theme	Secondary Theme	Key-Considerations
BE	**Blockchain Banking Enabler Context**	Interbank Blockchain Collaboration	KYC Documentation
			Payment Settlements
		New Banking Services	Metaverse Banking
			Cryptocurrency Investing
T	**Technological Context**	Smart Contact Perceived Benefits	Lower Transactional Costs
			Improved Transactional Speed
			Smart Contact Loans
		Blockchain Complexity	Smart Contact Coding
			Scalability
			Interoperability
O	**Organisational Context**	Organisational Readiness	Blockchain Research Team
		Top Management Support/Awareness	Blockchain Knowledge
			Blockchain Negative

			Associations
			Budget
E	**Environmental Context**	Regulatory Environment	Government Support
			Regulation Uncertainty
		Energy Consumption	Computational Power
IO	**Inter-Organisational Context**	Trust	KYC Documentation Trust
			Privacy

5.3 DISCUSSION OF SRQ1: BLOCKCHAIN ADOPTION EXPECTED VALUE

What is the expected value for the adoption of blockchain technology by commercial banks in SA as perceived by SA banking professionals and blockchain experts?

5.3.1 Purpose

Sub-Research Question 1 sought to identify the potential value which blockchain technology would render for commercial banks in SA if it was adopted in their organisations. Additionally, the question sought to understand the potential value from the perspectives of IT decision-makers employed within a South African commercial bank and blockchain experts. The expected value of blockchain adoption by commercial banks in SA is categorised under the theme of blockchain banking enablers. Each of the key considerations for this theme make up the answer of the expected value for blockchain adoption.

Theme 1 identifies the expected value for blockchain adoption by commercial banks in SA. Our interviewees showed immense enthusiasm regarding the value that blockchain may

render, believing that blockchain can contribute to banking organisations with regard to improved efficiencies, improved services and the strengthening of interbank relationships. Two primary themes, 3 secondary themes and 7 key considerations were identified as the expected value for blockchain adoption from the perspectives of IT decision-makers employed within a South African commercial bank and South African blockchain experts.

Key considerations represented as the expected value for blockchain adoption were identified through 2 primary themes. These primary themes included (1) blockchain banking enablers and (2) technological context. The identified secondary theme for blockchain banking enablers included interbank blockchain collaboration and new banking services. For each of these, key considerations were identified. The key considerations identified for interbank blockchain collaboration included KYC documentation and payment settlements, whereas the key considerations identified for new banking services included metaverse banking and cryptocurrency investing. Moreover, for the technological context, the secondary theme identified was smart contract perceived benefits. Within this secondary theme, the key considerations identified were lower costs and improved transactional speeds.

5.3.2 Blockchain Banking Enablers

5.3.2.1 Interbank Blockchain Collaboration

Our results found that blockchain technology enables communication amongst commercial banks in SA. According to PA1, blockchain technology is best utilised through collaboration with other commercial banks. Moreover, according to our results, interbank blockchain collaboration is an enabler for blockchain adoption in two respects: (1) KYC documentation, and (2) payment settlements.

5.3.2.1.1 KYC Documentation

KYC documentation makes provision for the verification of customers' identity within a bank. According to our participants, commercial banks in SA can leverage blockchain technology through KYC documentation as a means of collaboration. Our results show that both participant groups: blockchain experts and IT decision-makers employed in SA commercial banks, agreed that KYC documentation will serve as an enabler for blockchain adoption by SA commercial banks. PA3 mentioned that *"KYC will make it more efficient for all commercial banks and clients when creating a new banking account."*

An explanation for this may be that it would only require one commercial bank to store the KYC documents of a client on the blockchain and enable access of those documents to other participating commercial banks. Moreover, PA3 believed that blockchain-based KYC would decrease the administrative burden of clients and banks of validating the documents more than once.

This finding is in line with that of Thomson Reaters (2020), who found in a recent survey that some banks annually spend up to £300 million on KYC compliance. It was also found in the study that a large portion of this expense points to verification and independent checks of KYC documentations. KYC documents on the blockchain will only need to be verified by the blockchain once, which in turn significantly reduces the verification KYC costs faced by the bank.

Additionally, this finding also corresponds with Thavanathan (2017), who indicates that blockchain technology will facilitate interbank communication through KYC documentation. The communication between banks is necessary because banks would need to collaborate to successfully implement and maintain a mutual client's KYC documents. Furthermore, these findings along with the results of this study, further confirm that KYC documentation is an enabler for blockchain adoption by commercial banks in SA.

5.3.2.1.2 Payment Settlements

Our results from the participant responses also found that the settling of bank-to-bank payments are an enabler for blockchain adoption within the SA banking industry. Banks can use blockchain technology to create a digital currency used for settling payments from one bank to another. All participants agreed that the use of a digital currency will allow instantaneous transactions amongst banks. The instantaneous transactions make provision for faster settlement times of payments in comparison to traditional settlement times. Participant PA1 mentioned that a "consortium blockchain will ensure that inter-bank payment settlements are secure yet traceable". This consortium blockchain facilitates as a private blockchain between the participating banks. Moreover, our results found that blockchain payment settlements will also ensure lower transactional fees between banks. Participant PA2 mentioned that the use of a digital currency would eliminate a *"significant amount of fees for the banks and potential clients".* In addition, settlement payments which

are more efficient in terms of speed and price, serve as a motivator for adoption by the commercial banking industry in SA.

Furthermore, this finding is consistent with the white paper released by the South African Reserve Bank, whereby blockchain technology is in the process of implementation for South African bank-to-bank payment settlements. Project Khoka is a proof-of-concept project initiated by the SARB to create a digital currency of the South African Rand for interbank payment settlements. Moreover, the South African Reserve Bank acts as a mediator for banks in SA to collaborate to achieve faster payment settlements. Additionally, the project aims to achieve lower inter-bank payment fees through the implementation of a blockchain solution.

5.3.2.2 New Banking Services

Our results found that blockchain technology facilitates the creation of new banking services for the SA commercial banking industry. The new financial instruments which blockchain technology can help to facilitate are (1) metaverse banking and (2) cryptocurrency investing. These banking services can be facilitated through the implementation of blockchain-based projects. These findings were not identified in literature and emerge as a contribution for research of blockchain adoption in the industry of banking for developing countries.

5.3.2.2.1 Metaverse Banking

One unanticipated finding was that metaverse banking was viewed as an enabler for blockchain technology adoption in the SA banking industry. According to PB4, a payment architect for one of South Africa's leading blockchain based firms, metaverse banking refers to:

> *"a blockchain and augmented reality centred application or platform which allows clients to access banking services remotely, while still achieving an in-store presence."*

Moreover, the metaverse is a virtual world of Web 3.0, which creates a real world experience to work, live, shop and interact with other humans (Dioniso et al., 2022). The

implementation of metaverse banking would allow clients to access in-store services of a bank from remote locations.

All 3 of the participants who mentioned metaverse banking as an enabler for blockchain adoption were all blockchain experts from Participant Group B. Moreover, no participants employed within a bank (Participant Group A) mentioned metaverse banking. A possible explanation for this might be that blockchain experts are more rigorous in blockchain knowledge. These participants understand the potential of blockchain technology from a different perspective and field of knowledge in comparison to the IT decision-makers employed within commercial banks. For instance, PB1 is the co-founder of a blockchain-based Non-Fungible-Token (NFT) marketplace which also sells NFTs within the metaverse, therefore having a base of knowledge on the metaverse and its potential in the banking industry. Moreover, if a bank creates a metaverse platform as an additional service for clients, it creates an advantage over banks who have not taken an interest in the technology. Additionally, it also shows the commitment of the bank to innovation which serves the image of the bank well.

In addition to this, it was noted by 2 participants that the metaverse is still in its development phase and it may take years before it is fully developed. Therefore, this finding may be somewhat limited due to the time taken for full implementation of the metaverse concept. However, PB4 indicated that banks may still leap-frog competitors by creating their own metaverse platforms or applications to gain a first lead advantage. Furthermore, having the first metaverse based bank in SA may attract new clients and opportunities for the adopting bank because it creates a competitive advantage over late adopters in the banking industry, thus making it an enabler for banks to adopt blockchain technology within their organisations.

Finally, this result was not supported by existing literature and emerged as a new finding for blockchain enablers in the SA banking industry.

5.3.2.2.2 Cryptocurrency Investing

Blockchain technology can facilitate a new financial instrument for banks through the creation of a secure banking platform to trade and invest in cryptocurrencies. According to Taskinsoy (2021), many people view Bitcoin as digital gold and as a commodity. In

accordance with this, PB3 mentioned that certain cryptocurrencies could be displayed to banking clients to invest in a similar manner to that of gold, silver and stocks. Additionally, Prentis (2015) argues that Bitcoin is indeed a commodity, because it fits within the Commodity Exchange Act's (CEA) legal conception of a commodity. Banks can leverage blockchain technology by creating a new service or platform for investing clients to purchase cryptocurrencies which they believe are commodities. In contrast to this, Uddin et al. (2020) mention that cryptocurrencies such as Bitcoin are too volatile in comparison to gold and stocks, creating a large uncertainty for investors. It can be argued that both cryptocurrencies and other commodities such as stocks hold risks when investing. For banks to make a cryptocurrency available for purchase by their clients, precautions should be taken to educate clients on potential risks involved with trading.

In addition to this, PB2 indicated that banks can leverage trading of cryptocurrencies to increase their set of financial instruments. However, for Bitcoin to function as a trading commodity in a bank, it would need to comply with regulations around the commodity. However, PA1 mentions that there is no set framework for the trading of cryptocurrencies. The facilitation of cryptocurrency investing by commercial banks in SA was only identified as an enabler by Participant Group B, which constitutes blockchain experts. Moreover, Participant Group A, which constitutes IT decision-makers working within commercial banks, made no mention of cryptocurrency investments. The results from blockchain experts in this instance may have a bias towards cryptocurrency investing, or may lack knowledge around the commodity legislation that banks are required to follow. This is evident in PB2's support for the trade of cryptocurrencies by SA commercial banks, without mentioning the legal implications of trading cryptocurrencies, whereas PA1 mentioned that there is no legal framework formed yet for the trading of cryptocurrencies. This may indicate a bias towards the idea of banks adopting a cryptocurrency trading service. These findings should therefore be interpreted with caution.

5.3.3 Technological Expected Value

5.3.3.1 Perceived Benefits of Smart Contract

Our results show that smart contracts are a significant enabler to blockchain adoption within the South African banking industry. The IT decision-makers employed in South

African commercial banks and blockchain experts both agreed that smart contracts serve as a facilitator to benefitting the SA banking industry. Smart contracts enable multiple uses for SA commercial banks off which to leverage. Our results found 3 sources of utility which SA commercial banks can leverage off, namely (1) lower costs, (2) improved transaction speed and (3) smart contract loans. These 3 sources of blockchain utility are discussed below:

5.3.3.1.1 Lower Costs

The results show that there are various potential cost reductions in the South African commercial banking industry through the implementation of smart contracts. One participant, who is a blockchain consultant, identified that smart contracts would lower the costs of human error through their self-executing properties. Another participant, who is employed as the head of payments in a SA commercial bank, also suggested that smart contracts would lower transactional costs for banks, because they would require less human monitoring than a traditional transaction. Together, the present findings confirm that the implementation of a smart contract system in the banking environment, could significantly lower costs over time. In contrast to this, PA5, a head of IT of a SA commercial bank, indicated that although smart contracts may lower costs in the long term, they may require a vast amount of time to recoup the implementation cost. A possible explanation for this might be that the smart contracts require a high amount of investment and time to successfully implement, and the cost per transaction saved may not be very large. However, having lower transaction costs may attract new clients and retain existing clients, which may produce higher volumes of transactions, ultimately facilitating a faster recoupment of the smart contract implementation cost.

Moreover, these results corroborate the findings of a great deal of the previous work in the literature review in Chapter 2. Moreover, Wu et al. (2018) found that blockchain technology, through the use of smart contracts, could reduce costs in the financial industry through the reduction of manual processing. The time saved by employees due to blockchain technology could be used on value-adding activities to improve the efficiencies of the organisation. Additionally, according to a survey of 8 global banks conducted by Accenture (2020), it was found that blockchain technology could reduce the costs of clearing and settling $10 billion annually. These findings along with the results of this study

confirm that smart contracts are an enabler for blockchain adoption by banks through lowering costs in the banking organisation.

5.3.3.1.2 Improved Transaction Speed

The increased speed of transactions is also considered as a prominent enabler for blockchain adoption in the SA banking industry by both participant groups. Participant PA1, who is the head of the blockchain department in a SA commercial bank, emphasised the importance of the reduction of time required for a smart contract international transaction in comparison to a traditional bank international transaction. It was found that with smart contracts, the transaction time is almost instant whereby in a traditional bank, international transactions take between 1 to 5 days to clear. One of the interviewed experts in blockchain, PB2, confirmed that smart contracts could significantly improve transaction speeds for SA commercial banks through their “self-executing” properties. Moreover, the use of smart contracts in a banking environment allows for a wide range of business rules of the organisation to be coded into an autonomous system. This would allow banks to securely automate the clearing of high payment amounts.

5.3.3.1.3 Smart Contract Loans

In the results it was found that through the implementation of smart contracts, banks can facilitate a platform to allow blockchain lending through their institutions. According to BE4, smart contracts are independent, autonomous and make provision for interactions between two parties using “if, when and then” conditions which can be personalised to specific rules of a business or an organisation. Moreover, smart contracts can be programmed to have compliance and built-in control. In addition to this, smart contracts could also validate the loan eligibility of clients to determine whether they are eligible to receive a loan. Participant BE2 indicated that smart contracts “*provide well-defined conditions for lending in a banking environment*”. An explanation for this could be that smart contracts allow banks to create a contract with conditions based on the credit scores of clients and business rules of the bank to qualify for a loan. The smart contract will then automatically validate the client’s eligibility and approve or reject the loan application. Moreover, the smart contract could also be programmed to autonomously condition the amounts of the loan approved, associated with the interest to be paid by the client. This finding emerged as a new finding and was not supported by existing literature. However, loans with the use of smart contracts were mainly viewed as being used for the unbanked

(Mittal, 2018). Smart contracts make provision for people with no registered bank account to obtain a loan in cryptocurrency. The collaboration of smart contract loans with commercial banks allows loans to be obtained through the same configuration as that without a bank, with cryptocurrency as a means of payment of the loan.

5.4 DISCUSSION OF SRQ2 – BLOCKCHAIN ADOPTION CHALLENGES

What are the influential technological barriers hindering the adoption of blockchain technology by commercial banks in SA as perceived by SA banking professionals?

5.4.1 Purpose

The second sub-research question sought to understand what influential challenges are preventing the adoption of blockchain technology within SA commercial banks. The question required the explanation of barriers hindering adoption from the perspectives of only banking professionals, specifically IT decision-makers employed within a SARB recognised bank. The sub-themes and key considerations identified through the lens of the TOE framework are discussed below as a thorough answer to the question.

5.4.2 Technological Barriers

5.4.2.1 Blockchain Complexity

With respect to the second sub-research question, it was found that the complexity of blockchain technology is a barrier for blockchain adoption in the SA banking industry. Blockchain technology is viewed as a rapidly changing technology with new challenges emerging as the technology progresses. Moreover, because blockchain technology encompasses a rapidly changing nature, there are specific technical challenges which require new solutions to prevail before blockchain can be adopted within the SA banking industry. These technical challenges are viewed as intricate by IT decision-makers employed within SA commercial banks and are therefore preventing adoption within their organisations. Three specific technical challenges were identified: smart scalability, interoperability and smart contract coding. Each of these challenges are discussed below:

5.4.2.1.1 Scalability

Our results suggest that scalability is a constant concern for blockchain adoption. The storage of transactional records is viewed as problematic for a banking organisation due to the high volumes of daily transactions. Participant PA2, who is the head of payments for a

SA commercial bank, is specifically concerned with the proof-of-work mechanism of blockchain technology with regard to the large volumes of daily transactions. In addition to this, PA1, who is the head of the blockchain department in a SA commercial bank, emphasised that it would require a vast number of dedicated validators to scale the number of transactions on a blockchain network in a banking environment.

These results reflect those of Hassani et al. (2018) in the literature review of Chapter 2, who also found that the issue of scalability through the proof-of-work mechanism cause backlogs and time wastages in the instance of high-volume transactions. An explanation for these findings is that the proof of work mechanism requires all participants on a blockchain network to unanimously agree on which transactions are valid through executing a computational activity. In the instance of high-volume transactions of that within a traditional bank, it may take time for each participant to validate all transactions. Moreover, banks seek systems that are fast and capable to handle high volumes of transactions per second. In a banking environment, there are large volumes of transactions occurring daily, which would therefore require a relative number of validators to validate each transaction, hindering the essence of a scalable solution for transactions.

The issue of scalability may prevent SA commercial banks from adopting blockchain technology as a transactional utility. However, blockchain encompasses utility other than transactions. For instance, blockchain may be adopted within banking organisations for uses such as asset management, metaverse banking and KYC documentation as discussed in Section 5.2.1

In contrast to the issue of transactional scalability, one unanticipated finding from PB1, who is the CFO of a blockchain-based NFT marketplace, was that scalability is not as big of a threat to blockchain adoption as it was in the past. The reason for this is because he believed that the proof-of-work mechanism would soon be replaced with a proof-of-stake mechanism by organisations requiring higher volume transactions. The proof-of-stake mechanism does not require validators to solve algorithmic calculations to mine blocks on the network. Instead of this, blocks are validated by the amount of stake that the validator has on the network. Moreover, this finding is contrary to those of Zhou et al. (2019) and Hassani et al. (2020), who both found scalability to be the most significant challenge hindering blockchain adoption for organisations who use high volumes of transactions. A

possible explanation for this may be that the proof-of-stake mechanism has only recently received attention on its Conesus mechanism. According to Neureuter and Grey (2022), Ethereum merged from proof-of-work to proof-of-stake on 6 September 2022. Ethereum is the leading public blockchain after Bitcoin which created high anticipation for the merge. Moreover, other industries such as banking institutions may now follow Ethereum in migrating away from the proof-of-work mechanism, which in turn, creates a solution to the issue of scalability.

5.4.2.1.2 Interoperability

Participants employed within a SA commercial bank identified interoperability as a hinderance to blockchain adoption within their organisations. The challenge of collaborating in a blockchain system with the organisations' current legacy systems was identified as a barrier for adoption. Moreover, PA5, an IT head who specialises in the application and website of a SA commercial bank, was concerned with the complexity of integrating their current database of clients into a blockchain system database. He believed that integration of a blockchain system would be a challenge due to data interoperability. A differing view of the challenge of interoperability was that of the head of blockchain at a SA commercial bank, PA1, who mentioned that a blockchain technology system in a banking environment would require the integration of data amongst various entities such as government, the SARB and other commercial banks. The participant expressed that obtaining the data to integrate from these entities would be a salient task that would require the correct relationships and people. The concerns of PA5 and PA1 are both concerns of interoperability of blockchain systems. However, PA5 expressed the concern of physical data interoperability into existing legacy systems, whereas PA1 expressed the concern of data acquisition interoperability from other prominent entities. A reason for this difference in concern may be that the role of PA5 includes technical work such as improving the app and website of a bank, which is more focused on data being used, whereas the role of PA1 includes formulating and managing a blockchain team, which is more focused on data being acquired.

In accordance with the present results, previous studies have found that interoperability is a concern in the area of blockchain adoption. These findings are in line with those of Wharton (2018), who explained that for a blockchain solution to be adopted successfully, collaboration is required amongst all relevant business entities. Collaboration of other

entities requires data to be integrated with the blockchain system of commercial banks. This finding was also reported by Liang et al. (2018), who found that blockchain integration with existing legacy systems is a significant adoption hurdle for organisations due to the challenges of data interoperability and data access. In addition to this, ENISA (2016) sees that for the translation of blockchain formats and protocols, different blockchain ledgers will have to interact with each other.

5.4.2.1.3 Smart Contract Coding

The current study also found that acquiring the right talent for smart contract coding is a significant challenge for blockchain adoption in the SA banking industry. Smart contracts are vital for many of the enablers to blockchain adoption, including lower costs, faster transactional speeds and the management of assets. According to PA4, a smart contract team is the most important element of the allocated blockchain budget, before blockchain adoption can be achieved. In addition to this, PA5 indicated that finding a team to proficiently code in the smart contract language Solidity, was "*an unexpectedly difficult task*". This may indicate that there is a shortage of skills for smart contract coding in SA. Another reason for this may be that the smart contract language is fairly new and has only been focused on in recent years. Very little was found in the literature on the lack of skills for smart contract coding. However, Saheb and Mamaghani (2021) found that the interest for smart contract coding is increasing due to the increase in blockchain applications.

5.4.3 Organisational Barriers

5.4.3.1 Top Management Support

The support of top managers in the organisation was viewed as an important determinant for blockchain adoption in the SA banking industry. This finding was consistent with our organisational element in the TOE framework of Chapter 3. Top management support was a recurrent factor identified by Clohessy and Action (2019), for blockchain adoption within an organisational context. Our findings therefore confirm top management support as an important factor for the adoption of blockchain technology within the SA banking industry.

The results show that senior management in the SA banking industry are becoming increasingly aware of blockchain technology and its potential. However, although senior management are becoming increasingly aware, there is still a gap in knowledge of blockchain within the SA banking industry. Our participants have indicated that many

senior managers are still unclear on the actual potential which blockchain technology holds as a specific technology. The participants indicated 3 areas of concern hindering blockchain adoption in their organisations: (1) the lack of blockchain knowledge, (2) the negative associations that are aligned with blockchain technology, and (3) an allocated blockchain budget. These 3 findings are discussed below:

5.4.3.1.1 Blockchain Knowledge

The results show that there is a lack of an in-depth understanding of blockchain technology amongst senior management in SA banking organisations. The lack of blockchain knowledge was a recurring challenge identified by participants which is hindering blockchain adoption. Participant PA3 indicated that senior management mainly "*view blockchain specifically as Bitcoin or buying and selling a cryptocurrency*". This result may suggest that senior management generally understand blockchain technology as the elements of Blockchain 1.0 in Figure 3 of Chapter 2. These elements in Figure 3 constitute cryptocurrencies on a public blockchain such as Bitcoin and Ethereum. The understanding of Blockchain 1.0 is the simplest form of blockchain, facilitating a basic understanding of a single element of blockchain technology. According to Figure 3, there are 3 sectors of blockchain technology, going beyond cryptocurrencies. Moreover, blockchain 2.0 and Blockchain 3.0 constitute areas of digital identity, smart contracts and DApps, facilitating many more potential use-cases than just the trade of cryptocurrencies. However, the foundational understanding of blockchain technology by senior management creates a barrier to blockchain adoption by SA banking organisations.

According to PA1, senior management "*administer the budget allocated for blockchain, liaise with other entities for blockchain collaboration and provide credibility to the project at hand*". This suggests that without the support of senior management, a blockchain project would not be implemented. The credibility that senior management bares, provides confidence to the rest of the organisation. Moreover, a lack of blockchain knowledge by senior management would decrease the confidence by senior management for blockchain based projects. This lack of confidence constitutes a hindrance in blockchain adoption by the SA banking industry.

The lack of blockchain knowledge is also a significant challenge stipulated in current literature. Clohessy and Action (2019) indicated that because blockchain technology is a

new technology, the understanding of its technicalities and potential is not prevalent with the layman. In accordance with this, Saheb and Mamaghani (2020) also found in their study of blockchain adoption challenges in the developed banking industry, that blockchain knowledge is not strongly prevalent amongst top management in organisations. For blockchain adoption to be successfully implemented, banking organisations are required to increase blockchain awareness and knowledge within their organisations.

Contrasting to the finding encapsulating the lack of blockchain knowledge in banking organisations, one surprising result was that the organisation of PA2 had recently joined a blockchain research consortium. This consortium is dedicated to blockchain research for the financial services industry. The association with such a consortium allows for new knowledge of blockchain technology to constantly be at the disposal of top management. Moreover, this allows knowledge to be transferred within the organisation, facilitating an increase in blockchain knowledge for the organisation as a whole.

5.4.3.1.2 Blockchain Negative Associations

The study found that the negative associations of blockchain technology had caused a hindrance in adoption by top management in participants' organisations. Participant PA1 mentioned that the negative associations of blockchain technology had caused their organisation to not build up the in-house competencies to adopt blockchain technology. A possible explanation for this might be that cryptocurrencies are volatile in nature. Participant PA2 stated that the volatility in trade of cryptocurrencies in recent years had caused people to lose fiat money. Moreover, the volatility of the cryptocurrency market creates an unstable impression of cryptocurrencies. According to PA4, cryptocurrencies are frequently associated with blockchain technology by some seniors in their organisation. Senior management may be associating the loss of fiat money by people solely with blockchain technology. This may have created a lack of trust by top management for the technology as a whole.

Another explanation for the negative associations of blockchain technology might be that blockchain technology, specifically cryptocurrencies, are viewed negatively in the media. Participant PA5 indicated that a possible reason for mistrust of blockchain technology is because "*senior management know only what the media shows them in terms of blockchain*". Bitcoin has been infamously called a "bubble" since the crash of its value in

December 2017 (Risius & Spohrer, 2017). The term “bubble” in this context refers to Bitcoin growing in value until it inherently loses all of its value. This connotation of Bitcoin is associated with blockchain technology as a whole and may act as another reason for the hindrance of blockchain adoption by SA commercial banks. Moreover, the negative connotation of Bitcoin potentially losing all of its value in the future, may create uncertainty in the minds of blockchain adopters because Bitcoin is closely connotated to blockchain technology.

5.4.3.1.3 Budget

The study also found that a budget dedicated to blockchain related projects was a hinderance to adoption by SA commercial banks. One participant mentioned that blockchain technology implementation is costly, specifically in terms of research, infrastructure and human resources. For blockchain adoption to be successful within the SA banking environment, these elements require a budget allocation. Participant PA5 mentioned that top management was previously not prepared to allocate a high budget to blockchain implementation. The reason for this was the uncertainty of a solid blockchain use-case to help recoup the investment. However, PA4 mentioned that although the budget required for blockchain technology is high, he believes that having an early start in the blockchain industry will be beneficial to the banking organisation in the future. An explanation for this could be that having an early-mover advantage of a technology such as blockchain could serve many benefits to a banking organisation, such as those mentioned in Section 5.2 (new and improved banking services, smart contracts and interbank blockchain collaboration).

Furthermore, this finding is contrary to that of Mourouzis and Fillipou (2017), who found in their survey that top management in the organisations surveyed have a relatively large budget for blockchain projects, which could accelerate blockchain adoption. A note of caution is due here since only 1 participant indicated that top management was prepared to allocate a high budget to blockchain projects. Moreover, from the 2 participants who mentioned that blockchain implementation requires a high budget, 1 of the participants indicated that having an early-start in blockchain adoption will be advantageous to the banking organisation.

5.4.3.2 Organisational Readiness

The readiness of the organisation was considered an important factor for participants' organisations to adopt blockchain technology. The results show that there is a lack of organisational readiness within the South African banking environment for blockchain technology adoption. In total, 3 of the 5 participants indicated that their organisations are not yet ready to adopt blockchain technology. The reason for the organisational unreadiness according to all 3 participants was the lack of blockchain competent employees. Participants did not provide any other reason for organisational unreadiness of blockchain adoption by their organisations. This finding corresponds with existing literature which argues that financial organisations possessing sufficient human capital are more likely to adopt blockchain technology (Tapscott & Tapscott, 2016). The readiness of a banking organisation to adopt blockchain technology entails the importance of having a dedicated blockchain research team within the organisation.

5.4.3.2.1 Blockchain Research Team

Participants emphasised the importance of having a dedicated research team for blockchain technology. Participant PA4 indicated the lack of a business use case due to the lack of a research team within the organisation. Having a business use case for blockchain would provide clarity to the organisation on how to proceed with the blockchain project. Banking organisations who are still unclear on what to utilise blockchain for, are behind relative to banking organisations who understand blockchain's utility. With respect to this, PA2 indicated that his organisation is associated with a consortium dedicated to blockchain research and the utility of blockchain for the financial services industry. The association of the blockchain consortium with the organisation of PA2 may be why he also provided more insight into the enablers for blockchain adoption discussed in Section 5.1, compared to the other IT decision-makers. Having the insight of a team dedicated to blockchain research creates the opportunity and insight for new business use-cases for banking organisations to leverage.

However, these results are consistent with previous findings by Buitenhek (2016), who found that a lack of a business use case for blockchain in banks is a lingering barrier for blockchain adoption. In accordance with this, Saheb et al. (2021) also suggest that more internal blockchain research is required by organisations to formulate a strong business

use case to accelerate blockchain adoption. These findings correspond with the concerns of the IT decision-makers for the lack of a dedicated blockchain research team.

5.4.4 Environmental Barriers

The theme of environmental context refers to the environmental element of the TOE framework. The first identified element of the environmental context to assist in answering SRQ2, is regulatory environment. Regulatory environment consists of 2 key considerations, namely, government support and regulation uncertainty. The next identified element of the environmental context is energy consumption. The main and only key consideration of energy consumption is computational power. These factors are discussed below:

5.4.4.1 Regulatory Environment

The results confirm that the regulatory environment is an important factor for hindering the adoption of blockchain technology within the SA banking industry. Moreover, the interviewees' general view is that blockchain regulation should not be targeted at abstract perspectives, but rather targeted at specific issues. This specifically refers to the regulatory action on cryptocurrencies such as Bitcoin and Ethereum, instead of viewing specific regulatory action on blockchain as a technology.

5.4.4.1.1 Government Support

Our results found that governmental action for blockchain technology regulation may take years before migrating to a new decentralised regulation model. Participant PA1, who is the head of the blockchain department in a SA commercial bank, mentioned that the existing regulatory frameworks are underlined by centralised traditional models of security processing. PA1 believed that due to this, cross-jurisdiction cooperation will result in years of migration to a decentralised regulatory framework. In addition to this, PA4 indicated that the asset class of cryptocurrencies is new to the financial industry, hence the South African government has not prioritised the time to create the conforming policies for it.

PA2 mentioned that SA will follow the protocols and regulations created by countries who have already implemented conforming policies for the asset class of cryptocurrencies. However, regulation for cryptocurrencies are country specific, whereby different countries conform to different regulatory laws. The finding from PA2 is in line with Clohessy and

Acton (2019), who found that the Irish Government has not provided a voice on blockchain technologies as yet, resulting in slow blockchain adoption. Moreover, Ireland is a developed country, whereas SA is an undeveloped country. Governmental support of cryptocurrencies is country specific, whereby different countries conform to different regulatory laws. In line with this, PA2 also mentioned that he believes that the SA government will follow the regulatory action of government of developed countries, with a stronger focus on blockchain and cryptocurrencies. The support of the SA Government for blockchain technology may be a long process before success, because governments of developed countries such as Ireland are also lagging on the support of blockchain technology. Government support for blockchain technology is therefore a hinderance to blockchain adoption within the SA banking industry.

5.4.4.1.2 Regulation Uncertainty in SA

Another important finding was that the regulation around blockchain technology, specifically for cryptocurrencies, is unclear in SA. Participant PA5 mentioned the blockchain characteristic of “irreversibility” as a concern for regulation within the South African banking industry. A possible explanation for this is that transactions made on a blockchain network are irreversible and permanent for all participants on the network. Moreover, having an irreversible transaction creates a challenge for consumers of a bank when transacting. Although the blockchain transaction is fully traceable, the bank would still not hold the power to retract the transaction. This challenge creates the opportunity for fraudulent action within the SA banking environment. The challenge of uncertain regulation in the instance of fraudulent or inaccurate blockchain transactions by consumers lacks the repercussions necessary to solve this challenge. This finding is in line with existing literature by Kawasami et al. (2020), who found that the lack of regulation around blockchain technology creates a delay in the adoption of the technology. Additionally, this finding is inconsistent with that of Saheb and Mamaghani (2021), who found that the use of a private blockchain in organisations makes provision for reversible transactions in circumstantial situations such as theft. SA banks may use private blockchains to combat the issue of irreversibility, however, regulation is still required to provide a legislative understanding of potentially fraudulent transactions for banks who utilise blockchain payments.

5.4.4.2 Energy Consumption

One finding in line with literature is that the concern for the amount of energy consumed by blockchain technology is a challenge to adoption in the SA banking industry. According to Kawasmi et al. (2020), the consumption of energy in organisations is significantly less than that of a public blockchain. This also accords with our results by PA2, who mentioned that using a public blockchain for transactions in their organisation would be "*problematic for the environment with the amount of energy used daily*". One of the significant reasons for the high energy consumption associated with blockchain technology, is the computational power that it uses.

5.4.4.2.1 Computational Power

Our findings show that computational power is the leading cause for the high energy consumption of blockchain technology within organisations. According to Kulkarni and Patil (2020), for a block to be mined, it requires a miner on the blockchain network to validate that block by completing algorithmic calculations on a computer. In accordance with this, PA5 mentioned that mining a block on the chain requires computational power, however, mining in a banking environment requires high volumes of blocks to be mined, requiring even higher volumes of computational power than on a standard basis. The high amounts of computational power would also incur an expense to the organisation. Within the SA context, a constant supply of electricity has become a luxury to many due to rotational power cuts across the country. Moreover, having to use computational power on a constant basis would be difficult in a developing country such as SA. Banking organisations may need to invest in generators or inverters to power organisational computers during rotational power cuts. These generators incur high costs to the organisation, which may not be feasible for the banking institution and the environment.

Contrastingly, one unanticipated finding was that the computational power of mining a block could possibly be avoided through implementing a proof-of-authority mechanism instead of a proof-of-work mechanism in the banking organisation. Participant PA2 stated that a proof-of-authority mechanism would allow the bank to nominate a set number of trustworthy validators to mine the blocks. By doing this, computational power would be minimal in comparison to the power used in proof-of-work mechanisms. However, 1 possible problem with this solution is that it requires high levels of trust from the bank and consumers of the selected validators. Selected validators may find loopholes when

validating the transactions to advantage themselves of the people with whom they are associated.

5.4.5 Interorganisational Barriers

5.4.5.1 Trust

According to our results, blockchain technology in a banking environment is best utilised through collaboration with other banks. However, it was also found that for blockchain collaboration to be successful, commercial banks require trust amongst each other. One of the key characteristics of blockchain technology is transparency (Golosova & Romanovs, 2018). Although consortium blockchains are less transparent than a public blockchain, a blockchain shared amongst commercial banks still requires trust amongst participants on the network. Our finding of trust was underpinned by 2 important key considerations, (1) KYC documentation trust, and (2) privacy. These 2 key considerations are discussed below:

5.4.5.1.1 KYC Documentation Trust

One unanticipated finding was that trust of KYC documentation amongst commercial banks in SA is a challenge hindering the adoption of blockchain technology. KYC documents in a banking context are used to verify the identities of clients (Hassani et al., 2018). According to our results, blockchain technology makes provision for KYC documentation amongst commercial banks. This means that once a client's KYC documents are uploaded to the blockchain by one bank, all participating commercial banks on the network may have access to the client's information. PA5 identified the possibility of exploitation of data by the participating banks as a challenge for blockchain adoption. Moreover, having this type of access requires trust amongst all participating banks not to exploit the information of clients. An example of the exploitation of the client information could be where 1 of the commercial banks on the network uses the contact information of clients to pursue the clients to leave their current bank and join the bank of the latter. The idea of having clients poached by other banks on the blockchain network can create a barrier of mistrust amongst the banks on the network. Additionally, PA3 indicated that for successful blockchain-based KYC document implementation amongst commercial banks, there would need to be a strong relationship between the banks based on trust. This sentiment was supported and extended by PA5, who mentioned that for KYC implementation to be successful, firstly, it would require trust amongst participating banks,

and secondly, it would also require a signed agreement between participating banks preventing each other from exploiting data.

The finding of KYC documentation trust broadly supports the work of other studies who found that from a general perspective, trust is a challenge to blockchain adoption (Zutshi et al., 2021; Saheb & Mamaghani, 2021; Boukis, 2020). According to previous research, the concern of trust is more focused on the creation and validation of blockchains on a network by validators. Validators require trust amongst each other to successfully and collectively mine and validate a block on the network (Zutshi et al., 2021). However, according to our findings, the concern for trust is more focused on trust of data exploitation amongst commercial banks. Banking organisations may use consortium blockchains for KYC documentation, which creates the new challenge of KYC document trust amongst banks. Banks require trust amongst each other to handle the shared data using ethical principles. In the instance of one bank unethically handling the shared data, trust amongst all banks may deteriorate, which may cause a dissociation of collaboration.

5.4.5.1.2 Privacy

The results also found that privacy amongst banks was considered a challenge hindering interbank blockchain adoption. According to the blockchain banking enablers in Section 5.2.2, interbank blockchain collaboration enables payment settlement in a faster and cheaper manner than that of a traditional bank's payment settlement system. With the advantage of a more efficient interbank payment settlement system, the issue of privacy amongst banks emerges. PA1 commented that "*commercial banks will share a consortium blockchain for payment settlements*". According to Golosova and Romanovs (2018), the type of blockchain used enables different levels of transparency. In accordance with this, a consortium blockchain gives access to all transactions on the blockchain and to all members of the consortium network. Furthermore, this means that all banks collaborating to use blockchain to settle interbank payments will have access to each other's daily transactions. In support of this, PA5 mentioned that "*disclosing the bank's data can easily conflict with the organisation's data policies*". Privacy of transactions is not safeguarded by the consortium blockchain, which may require each collaborating bank to update their data policies to be in line with the updated transparent system.

Moreover, this finding was not found in existing literature as a challenge hindering blockchain adoption and emerged as a new finding. However, contrary to our findings, Toufaily et al. (2018) found that privacy is an enabler for blockchain adoption in the financial services industry. Privacy was viewed as an enabler for blockchain adoption because it improves trust amongst members of the financial services industry through the nature of transparency. The results of this study found that trust is opposingly a challenge for blockchain adoption in the SA banking industry. A possible reason for this could be that data is viewed as an important commodity for banks. Transparency of transactions amongst banks may make participating banks gain access to information pertaining to clients within each participating bank. According to PA3, client information can become a threat to each bank because it may create the "*unethical temptation of poaching other banks' clients*". Moreover, if one bank attempts to pursue a client of another collaborating bank to open an account with them, it may create further complications for the interbank payment settlement system.

5.5 DISCUSSION OF SRQ3 – CONTEXTUAL FRAMEWORK

What would a framework categorising the expected value and influential challenges of blockchain adoption in SA commercial banks look like?

One of the objectives of this research study was to develop a framework categorising the influential challenges and enablers of blockchain technology adoption within the SA banking industry. The framework can be utilised by policymakers and IT decision-makers throughout the banking industry of SA and other developing countries, to assist as a reference for strategy creation in accelerating blockchain adoption.

The categorisation consists of the utility which blockchain technology renders for the SA banking industry, as well as the influential technological, organisational, environmental and interorganisational challenges which blockchain technology adoption poses for commercial banks in SA. These factors are from the perspectives of IT decision-makers employed within a SARB recognised bank and blockchain experts who meet the criteria stipulated in Table 1 of Section 3.3.1. In addition to this, some of these factors are confirmed and

reinforced through existing literature and various new factors which are new due to the data collected and analysed in this research paper.

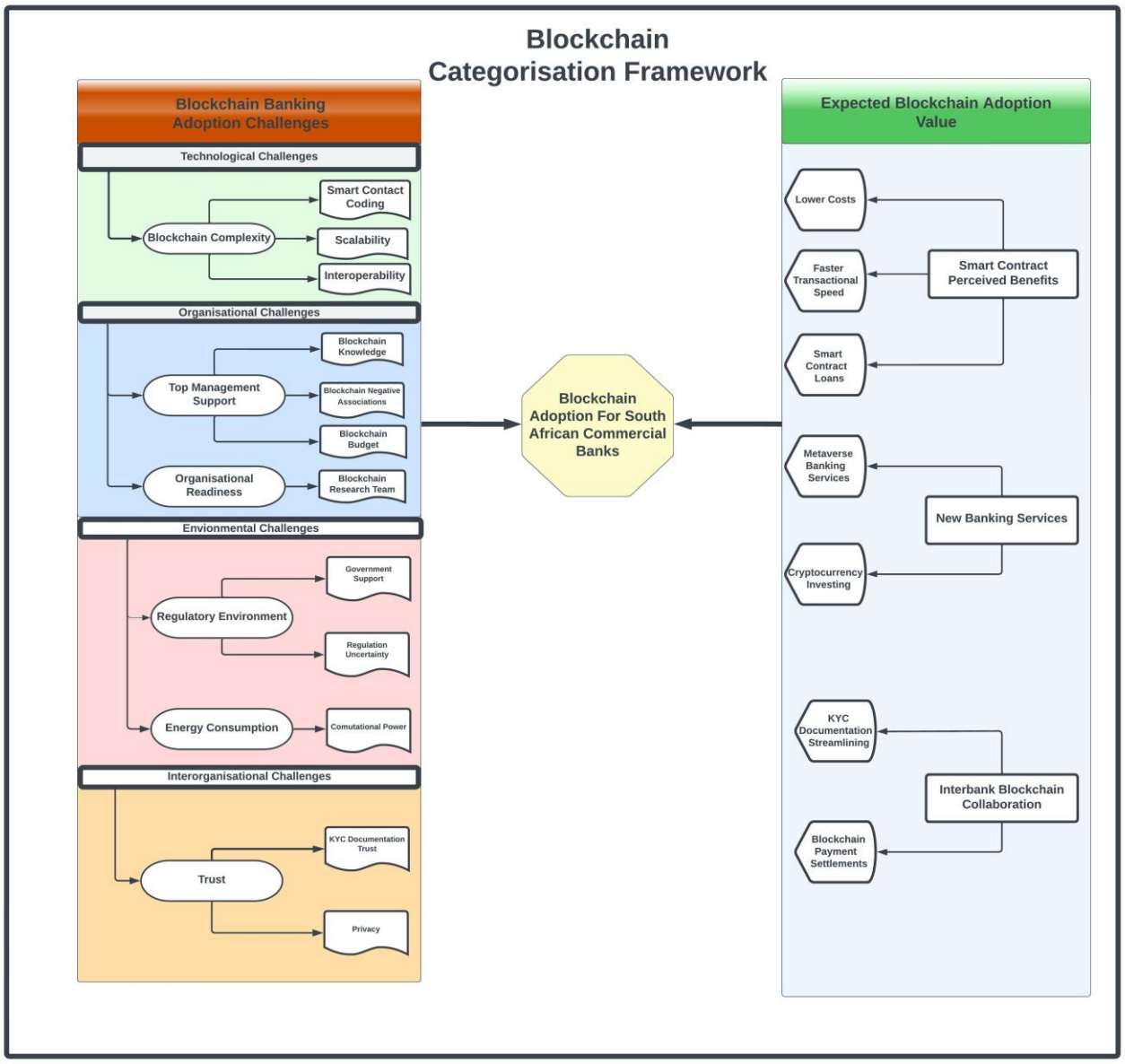

Figure 12: Categorisation of Factors Influencing Blockchain Adoption by South African Commercial Banks

Figure 12 presents the categorisation of the factors influencing blockchain adoption by commercial banks in SA. Each of these factors are categorised as challenges hindering the adoption of and the expected value for blockchain technology adoption for commercial banks in SA. The challenges hindering blockchain adoption are further categorised into technological challenges, organisational challenges, environmental challenges and

interorganisational challenges. Each of these elements provide challenges for blockchain adoption for SA commercial banks. These challenges provide additional specific challenges which come from the parent challenge. Moreover, the categorisation framework contains a total of 6 parent and 10 specific challenges from all of the elements.

The parent challenge for the technological element includes blockchain complexity. Within blockchain complexity, 3 specific challenges are presented. These 3 specific challenges are scalability, interoperability and smart contract coding. Scalability refers to the issue of a blockchain to simultaneously handle high amounts of transactions in comparison to a traditional banking system. Interoperability refers to the issue of integrating a blockchain system with a bank's current data and legacy system. The challenge of smart contract coding refers to the lack of skills and human capital within banking organisations for development of smart contracts. Smart contracts are the baseline of blockchain applications and specific skills are required to code smart contracts. One of the reasons for the lack of skills is due to smart contract coding languages being fairly new to the technology industry.

Moreover, the parent challenges for the organisational element includes top management support and organisational readiness. Within top management support, 3 specific challenges are presented. These 3 specific challenges are blockchain negative associations, blockchain knowledge and blockchain budget. The negative associations of blockchain technology encapsulate the idea that blockchain technology is solely associated with cryptocurrencies and is volatile. The volatility of cryptocurrencies is the leading reason of the negative associations of blockchain technology. The challenge of blockchain knowledge refers to the lack of understanding of the potential of blockchain technology by top management in commercial banks in SA. Blockchain technology is complex in nature and contains many different elements. As a result, top management are not fully understanding of blockchain technology and its full potential. The challenge of a blockchain budget refers to the unwillingness of top management to allocate a sufficient budget for blockchain projects. Blockchain projects are relatively costly and for adoption to be accelerated, a sufficient budget is required for projects and research. Next, within organisational readiness, 1 specific challenge is presented. This specific challenge is presented as the lack of a blockchain research team. The challenge of a blockchain research team refers to the lack of human capital and teams in commercial banks in SA

dedicated to blockchain technology research. One of the requirements for a dedicated blockchain research team in the SA commercial banking industry is to discover new business use-cases for blockchain technology and to stay updated with the technology.

Finally, the parent challenges for the environmental element include regulatory environment and energy consumption. The specific challenges for the regulatory environment are presented as government support and regulation uncertainty. Government support refers to the level of support that the SA government poses for blockchain adoption. Regulation uncertainty refers to the lack of legislation for cryptocurrencies in SA. There are no current regulations on blockchain technology or specifically, cryptocurrencies in SA. The uncertainty of regulation creates a barrier for blockchain adoption. The parent challenge of energy consumption includes 1 specific challenge. The specific challenge is presented as computational power. Computational power refers to the amount of energy being used to mine cryptocurrencies through blockchain's proof-of-work consensus mechanism. For a transaction to be validated, validators are required to solve algorithmic calculations on a running computer, therefore using high volumes of computational power and energy. Finally, the parent challenge for the interorganisational element includes trust. The specific challenges of trust are presented as KYC documentation trust and privacy. KYC documentation trust refers to commercial banks in SA trusting each other with KYC documents stored on the blockchain. Privacy refers to the transparent transactions on the blockchain of each bank collaborating for interbank payment settlements.

Furthermore, pertaining to the expected value of blockchain adoption for commercial banks, there are elements which broadly constitute the value that blockchain technology may render. In addition to this, each broad element of expected value presents specific value of blockchain adoption in relation to the broader element. Moreover, the categorisation framework contains a total of 3 broad elements of value and a total of 7 specific elements of value. The 3 broad elements of value are smart contract perceived benefits, new banking services and interbank blockchain collaboration. For the broad value element of smart contract perceived benefits, 3 specific value elements are presented. These 3 elements are lower costs, faster transactional speed and smart contract loans. For the second broad value element of new banking services, 2 specific value elements are presented. These 2 elements include metaverse banking services and cryptocurrency

investing. For the final broad value element of interbank blockchain collaboration, 2 specific value elements are presented. These 2 elements include KYC documentation streamlining and blockchain payment settlements.

5.6 CHAPTER 5 SUMMARY

This chapter discussed the findings of this study in relation to the main and sub-research questions of the study.

The expected value and benefits of blockchain adoption for commercial banks in the SA banking industry were explored in Section 5.3. Three key factors of the expected value were discussed which included new and improved banking services, interbank blockchain collaboration and smart contract perceived benefits. From these 3 key factors of expected value, metaverse banking and smart contract loans emerged as unanticipated findings in relation to existing literature. Payment settlements, KYC documentation, lower costs, improved transactional speed and cryptocurrency investing were found to be expected value of blockchain adoption by SA commercial banks and were confirmed by existing literature.

The challenges of blockchain adoption for commercial banks in the SA banking industry were explored in Section 5.4. Six key factors of the challenges were discussed which were blockchain complexity, organisational readiness, top management support, regulatory environment, energy consumption and trust. From these 6 key challenges of blockchain adoption, blockchain budget, KYC documentation trust and smart contract coding were unanticipated findings in relation to existing literature. Scalability, interoperability, blockchain knowledge, negative blockchain associations, blockchain research team, government support regulatory uncertainty, energy consumption and computational power were all challenges confirmed by existing literature.

A discussion of the categorisation was explored in Section 5.5. The categorisation constituted the findings discussed in Sections 5.3 - 5.4. The categorisation is divided into 2 broad categories, these being the challenges and expected value for blockchain adoption of commercial banks in SA. Within the category of challenges of blockchain adoption, 4 elements were devised with the guidance of the TOE framework. These elements included

the traditional TOE elements, namely technological, organisational and environmental. In addition to this, a fourth element was introduced as the interorganisational context which encompassed the interbank challenges of blockchain adoption. The categorisation may assist policymakers and IT decision-makers in the SA banking industry with strategy creation to help to accelerate blockchain adoption in their organisations.

PART VI – CONCLUSION

Part VI consists of Chapter 6 and entails the conclusion of the study. Figure 13 depicts the progress of the study.

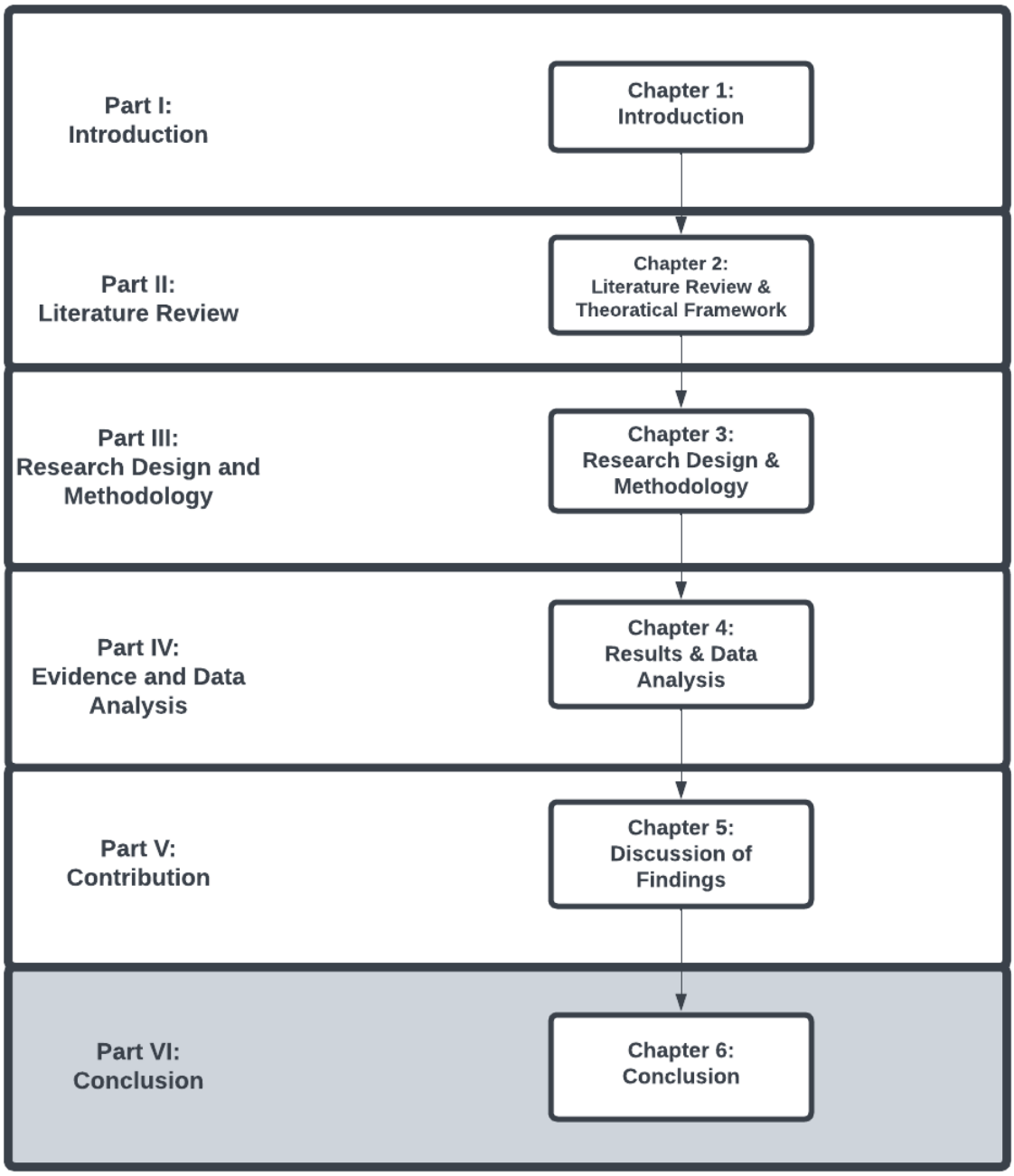

Figure 13: Part VI - Conclusion

6 CONCLUSION

6.1 INTRODUCTION

The purpose of this chapter is to summarise the findings of the research questions and to present the conclusion. The aim of the study was to explore the expected value and influential challenges of blockchain adoption within the SA banking industry. In addition to

this, the study aimed to create a categorisation of the expected value and challenges of blockchain adoption in SA commercial banks. This is to be used by IT decision-makers in commercial banking firms in SA and other developing countries as a tool for strategy creation and to assist with IT adoption decision-making.

The following main research question was formulated as a guide for the exploration:

What are the influential factors for the adoption of blockchain technology by commercial banking institutions in SA as perceived by IT decision-makers and blockchain experts in SA?

The following sub-research questions were formulated to guide the answer to the main research question:

- What is the expected value for the adoption of blockchain technology by commercial banks in SA as perceived by SA banking professionals and blockchain experts?
- What are the influential factors hindering the adoption of blockchain technology by commercial banks in SA as perceived by SA banking professionals?
- How would a categorisation of the expected value and influential challenges of blockchain adoption in SA commercial banks look?

This research study was broken down into 5 parts. Part I presented the introduction and background of the study. It encompassed Chapter 1 and Chapter 2. Chapter 1 presented the background information, purpose, problem statement, research questions, research objectives, assumptions and limitations of the study. Chapter 2 presented the literature review for blockchain adoption in the banking industry and presented the TOE framework which was used to guide the study. Part II presented the research design and methodology used for the study, which was encapsulated in Chapter 3. Part III contained Chapter 4, which aimed to analyse the data collected and present the results. Next, Part IV presented the study contribution through a discussion of the findings. These were presented in Chapter 5. Finally, Part V constitutes this chapter, which is to conclude the research study by providing a summary of findings of the study, concluding remarks, a summary of contributions and directions for future research.

The purpose of this interpretive study was to understand the key factors influencing blockchain technology adoption of SA commercial banks. The study was conducted with IT decision-makers employed within a SARB recognised commercial bank and SA blockchain experts. The IT decision-makers selected had knowledge of blockchain technology and IT adoption, whereas the blockchain experts had specific knowledge of blockchain technology. The TOE framework was used to guide the study in helping to formulate the interview questions and analyse the data of participant responses.

6.2 SUMMARY OF FINDINGS

This study implemented semi-structured interviews to understand the key factors of blockchain technology adoption by SA commercial banks from the perspectives of blockchain experts and IT decision-makers employed within SA commercial banks. The study found numerous challenges and expected value for the adoption of blockchain technology by SA commercial banks. In the attempt to understand the key factors of blockchain adoption by SA commercial banks, 5 themes emerged which provided an understanding of the key factors of blockchain adoption.

Theme 1 from the findings was blockchain banking enablers. This theme identified the motivators for SA commercial banks to adopt blockchain technology within their organisations. Within this theme, 2 secondary themes emerged, namely new and improved banking services and interbank blockchain collaboration. Within the first secondary theme of new and improved banking services, 1 unanticipated finding of metaverse banking services was found to be a key consideration for blockchain adoption by South African commercial banks. Participants believed that the metaverse would create opportunities for banks to leverage and create new banking services such as virtual financial instruments and face-to-face services. This finding was not found in existing literature and emerged as a new finding for blockchain adoption in the banking industry. In addition to this, cryptocurrency investing as a new banking service was also viewed as an enabler for banks to adopt blockchain technology. Participants provided insight that banks can increase their service offerings through introducing the trade of cryptocurrencies as a new financial service for clients. The second secondary theme that emerged included interbank blockchain collaboration. Participants provided insight that blockchain technology would enable commercial banks to initiate collaboration amongst each other

and improve their business relationships. The key considerations identified for interbank blockchain collaboration included KYC documentation and payment settlements. KYC documentation entailed the creation of an interbank blockchain to store KYC documents of clients to improve efficiencies when clients open new accounts amongst the collaborating banks. The use of blockchain for KYC documentation amongst banks was numerously confirmed in literature as an enabler for blockchain adoption. In addition to this, participants identified that blockchain based payment settlements make provision for participating banks to clear payments in a faster and more cost-effective manner. This finding was also confirmed in literature as an enabler for banks to adopt blockchain technology.

Theme 2 from the findings encapsulated the technological context of the TOE framework. Within this theme, 2 secondary themes emerged. One of the secondary themes entailed the expected value of blockchain adoption, namely smart contract perceived benefits, whereas the other secondary theme entailed the technological challenges of blockchain adoption, namely blockchain complexity. For the first secondary theme of the technological context, smart contract perceived benefits, participants identified that smart contracts would lower costs for SA commercial banks, improve transactional speeds and enable smart contract loans. It was confirmed in literature that smart contracts would lower bank costs and improve transactional speeds. However, it was not found that smart contracts would enable loans for banks to leverage off. It was found that smart contracts enable loans for the unbanked, however, participants believed that banks could leverage the use of smart contracts and integrate their functionality to provide consumers with loans through cryptocurrencies. For the second secondary theme of the technological context, blockchain complexity, participants identified smart contract coding, scalability and interoperability as challenges hindering the adoption of blockchain technology within SA commercial banks. For the issue of scalability, participants were concerned that a blockchain based solution would not manage the number of transactions per second that a commercial bank in SA processes. Additionally, participants were concerned with the issue of interoperability due to the integration of high volumes of data from existing legacy systems to a blockchain based system. These challenges of scalability and interoperability were also confirmed in existing literature. Many participants highlighted that finding skilled smart contract coders was a serious issue for blockchain adoption in the SA commercial

banking industry. However, existing literature found that there was an increase in smart contract coders due to the influx of blockchain applications.

Theme 3 from the findings encapsulates the organisational context of the TOE framework. Within this theme, 2 secondary themes emerged as challenges of blockchain adoption within the SA commercial banking industry. These secondary themes included organisational readiness and top management support. The first secondary theme of organisational readiness included the key consideration of a blockchain research team. Many participants were concerned about the lack of organisational human capital pertaining to a dedicated team researching blockchain technology and its potential. Although 1 participant indicated that his organisation joined a blockchain consortium focused on blockchain research, existing literature confirmed that organisations lack human blockchain capital and require more internal knowledge on the topic of blockchain to accelerate blockchain adoption. The second secondary theme of the organisational context includes the support of top management. Three key considerations were identified for the support of top management, however, 1 of these key considerations emerged as a new finding. Firstly, the lack of blockchain knowledge and negative associations of blockchain were identified as concerns for IT decision-makers in terms of blockchain adoption in their organisations. Many IT decision-makers highlighted that top management either do not understand blockchain technology and its utilities, or associate the technology solely with cryptocurrencies. These findings are confirmed by existing literature whereby the lack of blockchain knowledge and the negative associations of blockchain technology are a challenge to the adoption of blockchain within the banking industry. Additionally, to these two key considerations, IT decision-makers mentioned that the lack of a dedicated blockchain budget may prevail as a challenge to blockchain adoption in the SA commercial banking industry. Many participants were concerned that top management have no interest in dedicating a sufficient budget to blockchain projects because they are wary of the potential that blockchain may render for their banking organisations. On the contrary, existing literature found that banking organisations are allocating high budgets to blockchain projects, whereas this study found that SA banking organisations are hesitant about the allocation of a sufficient blockchain budget.

Theme 4 from the findings encapsulates the environmental context of the TOE framework. Within this theme, 2 secondary themes emerged as findings. These findings included the

regulatory environment and energy consumption as challenges to blockchain adoption with the SA commercial banking industry. For the first secondary theme of regulatory environment, participants identified 2 key considerations. These key considerations are governmental support and regulation uncertainty. Many participants mentioned that governmental support was a challenge for blockchain adoption, because for the government to support blockchain adoption in SA commercial banks, it would require a change in traditional governmental models pertaining to SA commercial banks. Additionally, many participants mentioned regulation uncertainty in SA as a challenge for blockchain adoption in SA banks. IT decision-makers noted that SA has not provided any regulatory framework pertaining to blockchain technology, which in turn created uncertainty for commercial banks to fully adopt blockchain technology. Although some IT decision-makers noted that blockchain technology could still be adopted by commercial banks in SA for uses other than cryptocurrency, the same IT decision-makers mentioned that until there is more certainty on the regulation of blockchain within SA, blockchain adoption within SA commercial banks will not reach its full potential. This finding was numerously confirmed by literature, which indicated that blockchain regulation uncertainty in a country will slow down the rate of adoption (Kawasmi et al., 2020). The second secondary theme which emerged for the environmental context includes the challenge of energy consumption. The key consideration for energy consumption included computational power. IT decision-makers were concerned that blockchain-based transactions require high computational power which may be immoral for the environment and costly to banking institutions in SA due to the current challenge in SA pertaining to the lack of power. The concern for computational power as a challenge for blockchain technology was also confirmed by existing literature as discussed in Section 5.4.4.

Theme 5 from the findings encapsulates an extended element of the TOE framework, namely the interorganisational context. The interorganisational context pertains to the emergent challenges due to interbank collaboration facilitated by blockchain technology. Within the interorganisational context, the secondary theme of trust emerged. IT decision-makers viewed trust amongst commercial banks as a challenge for blockchain adoption within the SA banking industry. The challenge of trust amongst banks was also confirmed in literature as a challenge to blockchain adoption. Two key considerations were identified by IT decision-makers for the secondary theme of trust. These key considerations were KYC documentation trust and privacy. KYC documentation trust entails the level of trust

amongst banks for sharing of KYC documents of clients. IT decision-makers mentioned that trust becomes a consideration because collaborating banks may unethically exploit the KYC documents of participating banks clients. This finding was not supported by existing literature and emerged as a new finding. Additionally, privacy was also a key consideration mentioned by IT decision-makers as a challenge to blockchain adoption by SA commercial banks. This was because collaborating banks may share information of transactions pertaining to payment settlements, creating a breach to personal company transactional information. This finding was not confirmed by existing literature and emerged as a new finding for this research.

The study found technological, organisational, environmental and interorganisational challenges of blockchain adoption by SA commercial banks. Within these challenges, numerous secondary themes and key considerations were found to be additional challenges for blockchain adoption. In addition to this, the study found blockchain banking enablers as the expected value for blockchain adoption by SA commercial banks. Within the blockchain banking enabler theme, numerous findings were confirmed by existing literature and others were new unanticipated findings. The following sections (Section 6.2.1 and Section 6.2.2) will present the findings in terms of confirmed and new findings respectively.

6.3 SUMMARY OF CONTRIBUTIONS

The contribution of this study constituted a theoretical and a practical contribution. Each of these contributions are described in the following Section 6.4.1 and Section 6.4.2 respectively.

6.3.1 Theoretical Contribution

This study made a theoretical contribution to the academia of blockchain research adoption by contributing the expected value and challenges of blockchain adoption of SA commercial banks. This research will contribute to blockchain adoption research within the context of a developing country.

Additionally, this study contributed to the TOE framework by extending it in the context of blockchain technology adoption. The TOE framework was extended with 2 additional elements, (1) interorganisational and (2) blockchain enablers. The interorganisational

element refers to interbank blockchain adoption. Moreover, it encompasses the challenges of collaboration amongst banks. The challenges identified within the interorganisational context included trust. The 2 key considerations noted from the challenge of interorganisational trust, are (1) KYC documentation trust, and (2) privacy. Next, blockchain enablers refer to the influential factors for an organisation to adopt blockchain technology, which do not fit within the perceived advantage factor of the technological element in the TOE framework. The banking enablers also functioned as the expected value for blockchain adoption by SA commercial banks. These banking enablers are (1) interbank blockchain collaboration, and (2) new banking services. Interbank blockchain collaboration refers to the collaboration amongst commercial banks in SA to facilitate KYC documents and improve payment settlements. The new banking services refer to potentially new financial instruments which banks may offer through the adoption of blockchain technology. These new banking services include metaverse banking and cryptocurrency investing.

6.3.2 Practical Contribution

As a practical contribution, this study proposed a categorisation framework of the key factors of blockchain adoption for SA commercial banks. Policymakers and IT decision-makers within commercial banks in SA and other developing countries looking to adopt blockchain technology can use the categorisation framework as a reference for strategy creation. The framework may contribute to the policymakers who create policies for commercial banks in SA to identify and understand challenges pertaining to blockchain technology adoption. Additionally, understanding the key factors is important when improving, designing and implementing blockchain technology within a banking institution, which contributes to the improvement and innovation of the SA banking industry. Commercial banks in developing countries may also learn from this study and use the framework to align with their own innovative interests for blockchain adoption.

6.3.3 Research Limitations

It is important to note that this study had 3 limitations. Firstly, the key limitation of this study pertained to the sample of IT decision-makers in commercial banks in SA accepting the interview. One out of 2 of the samples was limited to only 5 full-length interviews with IT decision-makers in the SA context. Many prospective participants declined the interview

due to not being authorised to provide confidential information or plans of their respective organisations on the topic of blockchain technology.

Secondly, participants who were interviewed requested certain information to be withheld once a summary of the main points of the interview was sent back to them after the interview was completed. This means that the information withheld could have enhanced the outcomes of the research.

Lastly, this study was set to explore the influential factors for blockchain adoption in the SA banking industry, and therefore did not focus on a specific blockchain adoption model. For instance, the challenges hindering the adoption of a blockchain Peer-to-Peer (P2P) model may be more specific or significantly different to the challenges hindering the adoption of a Blockchain as a Service (BaaS) model.

6.3.4 Recommendations for Future Research

Future researchers could retest the findings of this study in developing countries other than SA. This will assist in determining whether blockchain technology adoption has the same influence and impact in other developing countries. Moreover, future researchers could conduct the same study with a larger sample size of IT decision-makers. In addition to this, comparative studies could be conducted in a developed country from different regions such as the Middle East, Europe, or North America with a larger sample size.

Moreover, future researchers could conduct a comparative quantitative study to empirically test the factors identified for blockchain technology adoption. Future researchers could also conduct comparative studies to investigate the factors influencing blockchain adoption of a specific blockchain model of a bank. For example, researchers could specifically investigate the factors of a cryptocurrency, metaverse banking or smart contract blockchain-based adoption model of a commercial bank in a developing or developed country.

7 REFERENCES

Alharby, M., & Van Moorsel, A. (2017). Blockchain-Based Smart Contracts : a Systematic Mapping Study. *ArXiv*, 125–140. https://doi.org/10.5121/csit.2017.71011

Ali, O., Ally, M., Clutterbuck, & Dwivedi, Y. (2020). The state of play of blockchain technology in the financial services sector: A systematic literature review. *International Journal of Information Management*, *54*(May), 102199. https://doi.org/10.1016/j.ijinfomgt.2020.102199

Angelis, J., & Ribeiro da Silva, E. (2019). Blockchain adoption: A value driver perspective. *Business Horizons*, *62*(3), 307–314. https://doi.org/10.1016/j.bushor.2018.12.001

Awa, H. O., Ukoha, O., & Emecheta, B. C. (2016). Using T-O-E theoretical framework to study the adoption of ERP solution. *Cogent Business and Management*, *3*(1). https://doi.org/10.1080/23311975.2016.1196571

Beck, R., Avital, M., Rossi, M., & Thatcher, J. B. (2017). Blockchain Technology in Business and Information Systems Research. *Business and Information Systems Engineering*, *59*(6), 381–384. https://doi.org/10.1007/s12599-017-0505-1

Berdik, D., Otoum, S., Schmidt, N., Porter, D., & Jararweh, Y. (2021). A Survey on Blockchain for Information Systems Management and Security. *Information Processing and Management*, *58*(1), 102397. https://doi.org/10.1016/j.ipm.2020.102397

Bergquist, J. (2017). *Blockchain Technology and Smart Contracts: Privacy-preserving Tools*. *17023*, 62.

Bhattacharya, S. (2021). Blockchain in the banking industry: Disruptive threats or lucrative opportunities? Journal of Business Research, 129, 342-356. doi: 10.1016/j.jbusres.2021.04.035

Böhme, R., Christin, N., Edelman, B., & Moore, T. (2015). Bitcoin: Economics, technology, and governance. Journal of Economic Perspectives, 29(2), 213-238.

Borse, M., Shendkar, P., Undre, Y., Mahadik, A., & Patil, R. Y. (2022). A Review of Blockchain Consensus Algorithm. *Lecture Notes in Networks and Systems*, *444*, 415–426. https://doi.org/10.1007/978-981-19-2500-9_31

Boukis, A. (2020). Exploring the implications of blockchain technology for brand–consumer relationships: a future research agenda. *Journal of Product and Brand Management*, *29*(3), 307–320. https://doi.org/10.1108/JPBM-03-2018-1780

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77-101. doi: 10.1191/1478088706qp063oa

Buitenhek, M. (2016). Blockchain: Gateway to innovation. The potential of blockchain for financial services. Amsterdam, NL: ING.

Busetto, L., Wick, W., & Gumbinger, C. (2020). How to use and assess qualitative research methods. *Neurological Research and Practice*, *2*(1). https://doi.org/10.1186/s42466-020-00059-z

Camarate, J., & Brinckmann, S. (2018). A Marketplace without boundaries 2.0: Digital disruption in the South African banking sector. *Strategy&*, 16. https://www.bbrief.co.za/content/uploads/2018/12/PwC-Future-of-Banking-in-SA-Viewpoint_vFinal.pdf

Chang, V., Baudier, P., Zhang, H., Xu, Q., Zhang, J., & Arami, M. (2020). How Blockchain can impact financial services – The overview, challenges and recommendations from expert interviewees. *Technological Forecasting and Social Change*, *158*(April), 120166. https://doi.org/10.1016/j.techfore.2020.120166

Chang, V., Baudier, P., Zhang, H., Xu, Q., Zhang, J., & Arami, M. (2020). How Blockchain can impact financial services – The overview, challenges and recommendations from expert interviewees. *Technological Forecasting and Social Change*, *158*(April), 120166. https://doi.org/10.1016/j.techfore.2020.120166

Chen, Y., & Bellavitis, C. (2020). Blockchain disruption and decentralized finance: The rise of decentralized business models. *Journal of Business Venturing Insights*, *13*(November 2019), e00151. https://doi.org/10.1016/j.jbvi.2019.e00151

Chitiga-Mabugu, M., Henseler, M., Mabugu, R., & Maisonnave, H. (2021). Economic and Distributional Impact of COVID-19: Evidence from Macro-Micro Modelling of the South African Economy. *South African Journal of Economics*, *89*(1), 82–94. https://doi.org/10.1111/saje.12275

Christidis, K., & Devetsikiotis, M. (2016). Blockchains and Smart Contracts for the Internet of Things. *IEEE Access*, *4*, 2292–2303. https://doi.org/10.1109/ACCESS.2016.2566339

Clemons, E. K., & Weber, B. W. (1990). Strategic information technology investments: Guidelines for decision making. *Journal of Management Information Systems*, *7*(2), 9–28. https://doi.org/10.1080/07421222.1990.11517887

Climate Transparency Report. (2020). South Africa South Africa. *Economic Outlook*, *14*(2005), 17131.

Clohessy, T., & Acton, T. (2019). Business Transformation through Blockchain. *Business Transformation through Blockchain*, *January 2019*. https://doi.org/10.1007/978-3-319-98911-2

Clohessy, T., & Acton, T. (2019). Investigating the influence of organizational factors on blockchain adoption: An innovation theory perspective. *Industrial Management and Data Systems*, *119*(7), 1457–1491. https://doi.org/10.1108/IMDS-08-2018-0365

Clohessy, T., Treiblmaier, H., Acton, T., & Rogers, N. (2020). Antecedents of blockchain adoption: An integrative framework. *Strategic Change*, *29*(5), 501–515. https://doi.org/10.1002/jsc.2360

Cocco, L., Pinna, A., & Marchesi, M. (2017). Banking on blockchain: Costs savings thanks to the blockchain technology. *Future Internet*, *9*(3), 1–20. https://doi.org/10.3390/fi9030025

Collomb, A., & Sok, K. (2016). Blockchain / Distributed Ledger Technology (DLT): What Impact on the Financial Sector? *Digiworld Economic Journal*, *103*(9), 93. www.comstrat.org

Del Río, C. A. (2017). Use of distributed ledger technology by central banks: A review. *Enfoque UTE*, *8*(5), 1–13. https://doi.org/10.29019/enfoqueute.v8n5.175

Deloitte. (2020). Blockchain in banking: A path to growth. https://www2.deloitte.com/content/dam/Deloitte/in/Documents/financial-services/in-fs-blockchain-in-banking-a-path-to-growth-noexp.pdf

Deshpande, A., Stewart, K., Lepetit, L., & Gunashekar, S. (2017). Understanding the landscape of Distributed Ledger Technologies/Blockchain. *British Standards Institution*, *May*, 82. https://www.rand.org/pubs/external_publications/EP67133.html

Di Francesco Maesa, D., & Mori, P. (2020). Blockchain 3.0 applications survey. *Journal of Parallel and Distributed Computing*, *138*, 99–114. https://doi.org/10.1016/j.jpdc.2019.12.019

Dwivedi, Y. K., Wade, M. R., & Schneberger, S. L. (2012). Informations Systems Theory: Vol.2. *Springer*, *28*(November), 461. https://doi.org/10.1007/978-1-4419-6108-2

Efanov, D., & Roschin, P. (2018). The all-pervasiveness of the blockchain technology. *Procedia Computer Science*, *123*, 116–121. https://doi.org/10.1016/j.procs.2018.01.019

FinMark Trust. (2019). FinScope South Africa 2019 pocket guide. *FinScope*, 1–21. https://finmark.org.za/search?locations%5B%5D=ZAF

Frizzo-Barker, J., Chow-White, P. A., Adams, P. R., Mentanko, J., Ha, D., & Green, S. (2020). Blockchain as a disruptive technology for business: A systematic review. *International Journal of Information Management*, *51*(November 2019), 102029. https://doi.org/10.1016/j.ijinfomgt.2019.10.014

Frizzo-Barker, J., Chow-White, P. A., Adams, P. R., Mentanko, J., Ha, D., & Green, S. (2020). Blockchain as a disruptive technology for business: A systematic review. *International Journal of Information Management*, *51*(October 2019), 102029. https://doi.org/10.1016/j.ijinfomgt.2019.10.014

Garg, P., Gupta, B., Chauhan, A. K., Sivarajah, U., Gupta, S., & Modgil, S. (2021). Measuring the perceived benefits of implementing blockchain technology in the banking sector. *Technological Forecasting and Social Change*, *163*(October 2020), 120407. https://doi.org/10.1016/j.techfore.2020.120407

Goldkhul, G. (2012). Pragmatism vs interpretivism in qualitative information systems research. *European Journal of Information Systems*, *21*(2), 135–146.

Golosova, J., & Romanovs, A. (2018). The advantages and disadvantages of the blockchain technology. *2018 IEEE 6th Workshop on Advances in Information, Electronic and Electrical Engineering, AIEEE 2018 - Proceedings*, 32–37. https://doi.org/10.1109/AIEEE.2018.8592253

Gómez-Puig, M., & Sosvilla-Rivero, S. (2021). Is blockchain the solution to financial inclusion? Journal of Business Research, 133, 241-254.

Hassani, H., Huang, X., & Silva, E. (2018). Banking with blockchain-ed big data. *Journal of Management Analytics*, *5*(4), 256–275. https://doi.org/10.1080/23270012.2018.1528900

Hennink, M., & Kaiser, B. N. (2022). Sample sizes for saturation in qualitative research: A systematic review with meta-analysis. Human Organization, 81(1), 20-30. doi: 10.17730/humo.81.1.u32636j8802648v5

Hou, S., Ma, M., & Wang, T. (2020). Blockchain for trade finance: A systematic literature review. Journal of Business Research, 116, 42-54.

Hu, Y., Liyanage, M., Mansoor, A., Thilakarathna, K., Jourjon, G., & Seneviratne, A. (2018). Blockchain-based Smart Contracts - Applications and Challenges. *Future Internet*, 1–26. http://arxiv.org/abs/1810.04699

Hughes, A., Park, A., Kietzmann, J., & Archer-Brown, C. (2019). Beyond Bitcoin: What blockchain and distributed ledger technologies mean for firms. *Business Horizons*, *62*(3), 273–281. https://doi.org/10.1016/j.bushor.2019.01.002

Hughes, D. (2017). The Impact of Blockchain Technology on the Construction Industry. In *animal Media*. https://medium.com/the-basics-of-blockchain/the-impact-of-blockchain-technology-on-the-construction-industry-85ab78c4aba6

Irakoze, G. (n.d.). ERP implementation success framework for developing countries: Case of South African SMEs. *Unpublished Master of Commerce in Information System Thesis: University of Cape Town*, *53*(July), 227. http://library.wur.nl/WebQuery/wurpubs/fulltext/353506

Jackson, B. (2018). *Understanding the Implication of Blockchain Technology on the Audit Profession*.

Janssen, M., Weerakkody, V., Ismagilova, E., Sivarajah, U., & Irani, Z. (2020). A framework for analysing blockchain technology adoption: Integrating institutional, market and technical factors. *International Journal of Information Management*, *50*, 302–309. https://doi.org/10.1016/j.ijinfomgt.2019.08.012

Kashyap, R., & Saurav, V. (2021). Blockchain technology: Road to transform the Indian banking sector. *Materials Today: Proceedings*, 2–5. https://doi.org/10.1016/j.matpr.2021.02.774

Kawasmi, Z., Akwasi Gyasi, E., & Dadd, D. (2020). Blockchain Adoption Model for the Global Banking Industry. *Journal of International Technology and Information Management*, *28*(4).

Kelley, K., Clark, B., Brown, V., & Sitzia, J. (2003). Good practice in the conduct and reporting of survey research. *International Journal for Quality in Health Care*, *15*(3), 261–266. https://doi.org/10.1093/intqhc/mzg031

Klein, K. J., & Myers, M. D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. MIS Quarterly, 23(1), 67-93. doi: 10.2307/249410

Kshetri, N., & Voas, J. (2018). Blockchain in Developing Countries. *IT Professional*, *20*(2), 11–14. https://doi.org/10.1109/MITP.2018.021921645

Kulkarni, M., & Patil, K. (2020). Block Chain Technology Adoption for Banking Services- Model based on Technology-Organization-Environment theory. *SSRN Electronic Journal*, 1–11. https://doi.org/10.2139/ssrn.3563101

Kurki, J. (2016). *Blockchains and distributed ledgers in financial world–Opportunity or threat to banks((DISSERTAÇÃO)*. https://dspace.cc.tut.fi/dpub/handle/123456789/24336

Larios-Hernández, G. J. (2017). Blockchain entrepreneurship opportunity in the practices of the unbanked. *Business Horizons*, *60*(6), 865–874. https://doi.org/10.1016/j.bushor.2017.07.012

Leech, N. L., & Onwuegbuzie, A. J. (2011). Beyond Constant Comparison Qualitative Data Analysis: Using NVivo. *School Psychology Quarterly*, *26*(1), 70–84. https://doi.org/10.1037/a0022711

Leitch, C. M., Hill, F. M., & Harrison, R. T. (2010). The philosophy and practice of interpretivist research in entrepreneurship: Quality, validation, and trust. *Organizational Research Methods*, *13*(1), 67–84. https://doi.org/10.1177/1094428109339839

Liu, X., Farahani, B., & Firouzi, F. (2020). Distributed Ledger Technology. *Intelligent Internet of Things*, 393–431. https://doi.org/10.1007/978-3-030-30367-9_8

Lombard, J. A. (2017). *End-consumer trust and adoption of smart contracts in life insurance in South Africa*. *November*. https://repository.up.ac.za/handle/2263/64865

Maboe, R. (2018). *An Overview of Blockchain Technology in the South African Financial Industry*. *October*.

Myers, M. D. (2013). Qualitative research in business and management. Los Angeles, CA: Sage.

Myers, M. D., & Klein, H. K. (2011). A set of principles for conducting critical research in information systems. *MIS Quarterly: Management Information Systems*, *35*(1), 17–36. https://doi.org/10.2307/23043487

Myers, M. D., & Newman, M. (2007). The qualitative interview in IS research: Examining the craft. *Information and Organization*, *17*(1), 2–26. https://doi.org/10.1016/j.infoandorg.2006.11.001

Nair, G. R., & Sebastian, S. (2017). BlockChain Technology Centralised Ledger to Distributed Ledger. *International Research Journal of Engineering and Technology*, *4*(3), 2395–56. https://irjet.net/archives/V4/i3/IRJET-V4I3711.pdf

Neureuter, M., & Grey, D. (2022). The Ethereum Merge: Understanding Ethereum's Transition to Proof-of-Stake. IEEE Computer, 55(1), 22-28. doi: 10.1109/MC.2021.3117024

O'Leary, D. E. (2008). Gartner's hype cycle and information system research issues. *International Journal of Accounting Information Systems*, *9*(4), 240–252. https://doi.org/10.1016/j.accinf.2008.09.001

Onwuegbuzie, A. J. (2007). A call for qualitative power analyses. Quality & Quantity, 41(1), 105-121. doi: 10.1007/s11135-005-1098-6

Pal, A., Tiwari, C. K., & Behl, A. (2021). Blockchain technology in financial services: a comprehensive review of the literature. *Journal of Global Operations and Strategic Sourcing*, *14*(1), 61–80. https://doi.org/10.1108/JGOSS-07-2020-0039

Perdana, A., Robb, A., Balachandran, V., & Rohde, F. (2021). Distributed ledger technology: Its evolutionary path and the road ahead. *Information and Management*, *58*(3), 103316. https://doi.org/10.1016/j.im.2020.103316

Peters, G. W., & Panayi, E. (2016). Understanding modern banking ledgers through blockchain technologies: Future of transaction processing and smart contracts on the internet of money. *New Economic Windows*, 239–278. https://doi.org/10.1007/978-3-319-42448-4_13

Pudjianto, D., & Jin, H. (2009). The TOE framework and its application in the diffusion of innovations: A review. Journal of Information Systems and Technology Management, 6(1), 21-36. doi: 10.4301/S1807-17752009000100002

Pushing the Limits of Interbank Payment Settlement with Blockchain, (2020). https://pages.consensys.net/consensys-banking-and-finance-project-khokha-v2?utm_campaign=Enterprise

PWC, R., Camarate, J., & Brinckmann, S. (2017). A marketplace without boundaries. The future of banking: A South African perspective. *PWC Strategyand*, 1–19. https://www.pwc.co.za/en/assets/pdf/strategyand-future-of-banking.pdf

Qu, S. Q., & Dumay, J. (2011). The qualitative research interview. *Qualitative Research in Accounting and Management*, *8*(3), 238–264. https://doi.org/10.1108/11766091111162070

Rajnak, V., & Puschmann, T. (2020). The impact of blockchain on business models in banking. In *Information Systems and e-Business Management* (Issue 0123456789). Springer Berlin Heidelberg. https://doi.org/10.1007/s10257-020-00468-2

Risius, M., & Spohrer, K. (2017). A Blockchain Research Framework: What We (don't) Know, Where We Go from Here, and How We Will Get There. *Business and Information Systems Engineering*, *59*(6), 385–409. https://doi.org/10.1007/s12599-017-0506-0

Rogers, E. M. (1995). Diffusion of innovations (4th ed.). New York: Free Press.

Ruoti, S., Kaiser, B., Yerukhimovich, A., Clark, J., & Cunningham, R. (2020). Blockchain technology: What is it good for? *Communications of the ACM*, *63*(1), 46–53. https://doi.org/10.1145/3369752

Saheb, T., & Mamaghani, F. H. (2021). Exploring the barriers and organizational values of blockchain adoption in the banking industry. *Journal of High Technology Management Research*, *32*(2), 100417. https://doi.org/10.1016/j.hitech.2021.100417

Salahuddin, M., Vink, N., Ralph, N., & Gow, J. (2020). Globalisation, poverty and corruption: Retarding progress in South Africa. *Development Southern Africa*, *37*(4), 617–643. https://doi.org/10.1080/0376835X.2019.1678460

Sarnitz, T., & Maier, R. (2017). Blockchain for smart contracts: A state of the art review. In 2017 IEEE International Conference on Software Architecture Workshops (ICSAW) (pp. 75-78). IEEE. doi: 10.1109/ICSAW.2017.47

Saunders, M. (2009). Research methods for business students (5th ed.). Harlow, England: Pearson Education Limited.

Saunders, M., Lewis, P., & Thornhill, A. (2012). *Research methods for business students, Fifth edition, Prentice Hall*.

Semenova, V. (2020). Technology adoption theories in examining the uptake of blockchain technology in the framework of functionalist and interpretive paradigms. *Vezetéstudomány / Budapest Management Review*, *51*(11), 26–38. https://doi.org/10.14267/veztud.2020.11.03

Sfhea, R. N., & Orji, C. I. (2021). *The Potentials and Challenges of Blockchain Application in FinTech in the Developing Countries - a Mauritius experience*. *5*(1), 56–62.

Sharma, G. (2017). Impact Factor: Sampling Methods. *International Journal of Applied Research*, *3*(7), 749–752.

Sheth, H., & Dattani, J. (2019). Overview of Blockchain Technology. *Asian Journal of Convergence in Technology*, *05*(01), 1–4. https://doi.org/10.33130/ajct.2019v05i01.013

Sönmez, A. (2013). Research methodology and design. *Contributions to Management Science*, 63–112. https://doi.org/10.1007/978-3-319-02033-4_3

Staples, M., Falamak, S., Ponomarev, A., Rimba, P., Tran, A., Weber, I., Xu, X., & Zhy, J. (2017). D21 - Blockchain and DLT – Use cases. *Future Internet*, *May*, 61.

Swan, M. (2015). Blockchain: Blueprint for a new economy. O'Reilly Media, Inc.

Tapscott, D., & Tapscott, A. (2016). Blockchain revolution: How the technology behind bitcoin is changing money, business, and the world. New York, NY: Penguin.

Tasca, P., & Tessone, C. J. (2019). A Taxonomy of Blockchain Technologies: Principles of Identification and Classification. *Ledger*, *4*. https://doi.org/10.5195/ledger.2019.140

Thavanathan, J. (2017). Process Innovation with Blockchain in Banking - A case study of how Blockchain can change the KYC process in banks. *NTNU Open*, *September*. https://brage.bibsys.no/xmlui/handle/11250/2489996

The African Blockchain Report (2021). Available at: https://www.standardbank.com/static_file/StandardBankGroup/filedownloads/AfricanBlockchainReport.pdf.

Tornatzky, L. G., & Fleischer, M. (1990). The processes of technological innovation. Lexington Books

Toufaily, E., Zalan, T., & Dhaou, S. Ben. (2021). A framework of blockchain technology adoption: An investigation of challenges and expected value. *Information and Management*, *58*(3), 103444. https://doi.org/10.1016/j.im.2021.103444

Trotter, R. T. (2012). Qualitative research sample design and sample size: Resolving and unresolved issues and inferential imperatives. *Preventive Medicine*, *55*(5), 398–400. https://doi.org/10.1016/j.ypmed.2012.07.003

Underwood, S. (2016). Blockchain beyond bitcoin. Commun. ACM, 59(11), 15-17. doi: 10.1145/2994581

Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing and Health Sciences*, *15*(3), 398–405. https://doi.org/10.1111/nhs.12048

Watkins, D. C. (2012). Qualitative research: The importance of conducting research that doesn't "count." *Health Promotion Practice*, *13*(2), 153–158. https://doi.org/10.1177/1524839912437370

Webster, J., & Watson, R. T. (2002). Analyzing the Past to Prepare for the Future: Writing a Literature Review. *MIS Quarterly*, *26*(2), xiii–xxiii. https://doi.org/10.1.1.104.6570

Xu, X., Xu, Z., & Liu, Y. (2018). Adaptable blockchain-based systems: A case study for product traceability. Journal of Systems and Software, 144, 306-316. doi: 10.1016/j.jss.2018.07.050

Yang, X., Long, Y., & Peng, X. (2020). A review on scalability of blockchain. Journal of Physics: Conference Series, 1511, 012090. doi: 10.1088/1742-6596/1511/1/012090

Yaga et al., 2018 NISTIR 8202. Blockchain Technology Overview. Available at: https://csrc.nist.gov/ publications/detail/nistir/8202/final

Yoo, S. (2017). Blockchain based financial case analysis and its implications. *Asia Pacific Journal of Innovation and Entrepreneurship*, *11*(3), 312–321. https://doi.org/10.1108/apjie-12-2017-036

Zachariadis, M., Hileman, G., & Scott, S. V. (2019). Governance and control in distributed ledgers: Understanding the challenges facing blockchain technology in financial services. *Information and Organization*, *29*(2), 105–117. https://doi.org/10.1016/j.infoandorg.2019.03.001

Zhang, S., & Lee, J. H. (2020). Analysis of the main consensus protocols of blockchain. *ICT Express*, *6*(2), 93–97. https://doi.org/10.1016/j.icte.2019.08.001

Zheng, Z., Xie, S., Dai, H. N., Chen, X., & Wang, H. (2018). Blockchain challenges and opportunities: A survey. *International Journal of Web and Grid Services*, *14*(4), 352–375. https://doi.org/10.1504/IJWGS.2018.095647

Zheng, Z., Xie, S., Dai, H., Chen, X., & Wang, H. (2017). An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends. *Proceedings - 2017 IEEE 6th International Congress on Big Data, BigData Congress 2017*, 557–564. https://doi.org/10.1109/BigDataCongress.2017.85

Zutshi, A., Grilo, A., & Nodehi, T. (2021). The value proposition of blockchain technologies and its impact on Digital Platforms. *Computers and Industrial Engineering*, *155*(February), 107187. https://doi.org/10.1016/j.cie.2021.107187

8 APPENDICES

8.1 APPENDIX A: BLOCKCHAIN CONSENT FORM

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Economic and Management Sciences

1. Introduction

You are invited to take part in a research study. This information leaflet will help you decide if you would like to participate. Before you agree to take part, you should fully understand what is involved. If you have any questions that this leaflet does not fully explain, please do not hesitate to ask the research personnel

2. Project information

2.1 Title of research project: **Factors Influencing Adoption of Blockchain Technology by South African Commercial Banks**

2.2 Researcher details: **Reshaad Cassim, Department of Informatics, Email: reshaad.cassim@up.ac.za , Contact Number: +27731111786**

2.3 Supervisor Details: **Prof Hanlie Smuts, Head of Department of Informatics at the University of Pretoria, Email: hanlie.smuts@up.ac.za**

2.4 Research study description

The research study aims to explore and understand the factors which may influence the adoption of blockchain technology by commercial banks in the South African context from the views of IT decision-makers working in South African banks, as well as from the views of blockchain experts.

Research Objectives:

- To explore the expected value for adopting blockchain technology in commercial banks in South Africa through the understanding of IT decision-makers and blockchain experts in the South African context.
- To explore the technological challenges of adopting blockchain technology by commercial banks as perceived by IT decision-makers in the SA context.
- To explore the organisational challenges of adopting blockchain technology by commercial banks as perceived by IT decision-makers in the SA context.
- To explore the environmental challenges of adopting blockchain technology by commercial banks as perceived by IT decision-makers in the SA context.
- To create a holistic framework classifying the technological, organisational and environmental factors and expected value for the adoption of blockchain technology

by SA commercial banks to be used by IT decision-makers in commercial banking firms in SA and other developing countries as a tool for strategy creation and to assist with IT adoption decision making.

2.5 **What will be required of participants?**

You are being invited to participate in this study because your profile matches the inclusion criteria for this study. Your input and understanding of blockchain technology and / or technology adoption will help to gain insight into the factors that may impact the adoption of blockchain technology in South African commercial banks. You will be asked a series of blockchain and IT adoption related questions and you are required to answer them to your best knowledge and opinion. I will set up a formal meeting virtually which will take a maximum of 1 hour. I will then request permission to voice record the session for purposes of the dissertation. At the end of the interview, the participant will be emailed a document with a summary of the main points captured by the researcher to confirm if what was captured is accurate to what was discussed. Your name and organisation name will be **kept confidential and completely anonymous** throughout the research report.

Are there any negative consequences for me if I participate in the research project?

There are no foreseeable negative consequences in taking part of this study as we will just be having a conversation.

Your participation is voluntary and you may withdraw at any time from participation of the interview.

3. Informed consent

3.1 I, _____ hereby voluntarily grant my permission for participation in the project as explained to me by *Reshaad Cassim*

3.2 The nature, objective, possible safety and health implications have been explained to me and I understand them.

3.3 I understand my right to choose whether to participate in the project and that the information furnished will be handled confidentially. I am aware that the results of the investigation may be used for the purposes of publication.

3.4 Upon signature of this form, the participant will be provided with a copy.

Signed: _____ Date: _____

Witness: _____ Date: _____

Researcher: _____ Date: _____

_____ _____

Participant's signature **Date**

8.2 APPENDIX B: INTERVIEW QUESTIONS A:

Interview Questions: Participant Group A: IT Decision-Makers

1. Can you please provide information on your experience with IT adoption?
2. In your opinion, what benefits do you think blockchain technology could have on South African commercial banks if it is adopted within their organisations?
3. Do you think your organisation is technologically ready for the adoption of blockchain technology? - Prompt: Can you please explain why or why not?
4. Can you think of any other technological factors which may hinder the adoption of blockchain technology in your organisation?
5. How aware are other IT decision makers in your organization of the adoption of blockchain technology?
6. In your opinion, is the support of top management within your organisation considered as an important factor in the decision for adopting blockchain technology? - Prompt: Why do you say this?
7. Can you think of any other organisational factors which may hinder the adoption of blockchain technology within your organisations?
8. Do you think the regulatory environment may have an impact on the adoption of blockchain technology within your organisation? - Prompt: Can you please further explain why or why not?
9. In your opinion, will industry pressure or competitive pressure make an impact in the decision to adopt blockchain technology within your organisation? - Prompt: Can you please further explain why or why not?
10. Can you think of any other environmental factors which may hinder the adoption of blockchain technology within your organisations?

8.3 APPENDIX C: INTERVIEW QUESTIONS B:

Interview Questions: Participant Group B – Blockchain Experts

1. What is your experience with blockchain and / or financial technology?
2. Do you have any blockchain related projects published?
   - If yes, can you please provide more information on the project?
3. In your opinion, what benefits do you think blockchain technology could have on South African commercial banks if it is adopted within their organisations?

8.4 APPENDIX D: ETHICAL CLEARANCE APPROVAL

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

RESEARCH ETHICS COMMITTEE

Faculty of Economic and Management Sciences

Approval Certificate

20 April 2022

Mr R Cassim
Department: External department

Dear Mr R Cassim

The application for ethical clearance for the research project described below served before this committee on: 2022-03-11

Protocol No:	EMS060/22
Principal researcher:	Mr R Cassim
Research title:	Factors influencing the adoption of blockchain technology by South African commercial banks
Student/Staff No:	17103682
Degree:	Masters
Supervisor/Promoter:	Prof JL Smuts
Department:	External department

The decision by the committee is reflected below:

Decision:	Approved
Conditions (if applicable):	
Period of approval:	2022-04-26 - 2022-11-30

The approval is subject to the researcher abiding by the principles and parameters set out in the application and research proposal in the actual execution of the research. The approval does not imply that the researcher is relieved of any accountability in terms of the Codes of Research Ethics of the University of Pretoria if action is taken beyond the approved proposal. If during the course of the research it becomes apparent that the nature and/or extent of the research deviates significantly from the original proposal, a new application for ethics clearance must be submitted for review.

We wish you success with the project.

Sincerely

pp PROF JA NEL
CHAIR: COMMITTEE FOR RESEARCH ETHICS

Fakulteit Ekonomiese en Bestuurswetenskappe
Lefapha la Disaense tša Ekonomi le Taolo

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29 March 2023

To Whom It May Concern

CONFIRMATION OF LANGUAGE EDITING OF A MASTERS DISSERTATION:

FACTORS INFLUENCING THE ADOPTION OF BLOCKCHAIN TECHNOLOGY BY SOUTH AFRICAN COMMERCIAL BANKS

Herewith confirmation that the abovementioned dissertation, by Mr Reshaad Cassim, has been language edited.

Yours sincerely

K.N. Groenewald