Cape Peninsula University of Technology

EFFECT OF BLOCKCHAIN TECHNOLOGY ON PAYMENT SERVICES: A CASE OF A SOUTH AFRICAN COMMERCIAL BANK

by

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DECLARATION

I, **Mercia Theresa Abrahams**, declare that the contents of this thesis represent my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

05 August 2025

Signed **Date**

ABSTRACT

This study investigates the challenges and opportunities of adopting blockchain technology in payment services within a South African Commercial Bank, motivated by the problem that, despite blockchain's potential, its integration into traditional banking systems faces significant obstacles. The research seeks to identify the primary barriers hindering blockchain adoption, assess its potential impact, and evaluate the advantages it can bring to payment services. Employing an interpretive qualitative approach, data was collected through semi-structured interviews with sixteen subject matter experts at tactical and operational levels, and thematic analysis was used to interpret findings. Thematic analysis revealed significant challenges, including regulatory compliance, data privacy, technology integration, resource requirements, and a shortage of in-house blockchain expertise.

The research results underscore blockchain's potential to streamline payment processes, reduce transaction costs, enhance security, and improve operational efficiency, particularly in cross-border transactions and real-time settlements. The study finds that while blockchain technology can advance payment services, challenges related to legacy systems, regulatory ambiguity, and high initial costs hinder its seamless implementation. Importantly, the study highlights the need for strategic collaborations, investment in employee upskilling, and the establishment of clearer regulatory frameworks to ensure compliance and facilitate blockchain's full potential in the financial sector. The study's recommendations include establishing stronger regulatory frameworks, prioritising collaborative efforts to enhance data privacy, investing in technical upskilling, and exploring sustainable integration solutions. While the findings are specific to a single bank, the study provides a strategic framework for broader banking institutions seeking to leverage blockchain technology to enhance operational efficiency, competitiveness, and customer satisfaction in a rapidly digitising financial environment.

These findings have implications for financial institutions in similar regulatory environments, suggesting that a carefully structured approach to blockchain adoption could yield competitive advantages, reduced operational costs, and improved customer satisfaction. The study contributes to ongoing discussions on blockchain's role in the digital transformation of banking, offering a strategic framework for banks aiming to integrate distributed ledger technology within existing infrastructures while navigating the complexities of regulatory compliance and technical integration.

Keywords: Blockchain, payments, business model, scalability, privacy and security, global governance and cost.

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ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
AML	Ant-Money Laundering
API	Application Programming Interface
BCT	Blockchain Technology
CBDC	Central Bank Digital Currencies
CPU	Central Processing Unit
CPUT	Cape Peninsula University of Technology
Disk IO	Disk Input/Output
DLT	Distributed Ledger Technology
DNS	Domain Name System
DOI	Diffusion of Innovation
FFM	Fast Feeless Minerless
GAFAM	Google Amazon Facebook Apple Microsoft
GDPR	General Data Protection Regulation (European)
IBC Protocol	Inter-Blockchain Communication Protocol
ICBC	Industrial and Commercial Bank of China
ICO	Initial Coin Offerings
IDT Theory	Innovation Diffusion Theory
IT	Information Technology
KYC	Know Your Client
ML	Money Laundering
NASDAQ	National Association of Securities Dealers Automated Quotations
NFT	Non-Fungible Tokens
P2P	Peer2Peer
PEOU	Perceived Ease of Use
POPI	Protection of Personal Information Act
PoW	Proof of Work
PU	Perceived Usefulness
SARS	South African Revenue Services
SSI	Self-Sovereign Identity
SWIFT	Society for Worldwide Interbank Financial Telecommunications
TAM	Technology Acceptance Model
TOE	Technology Organisation Environment Framework
USB	Universal Serial Bus

CHAPTER ONE: INTRODUCTION

1.1 Introduction

World financial systems depend on payment systems to function effectively. Through these systems, funds are transferred between banks and other institutions to pay for economic and financial transactions throughout the whole economy (Pilipinas, 2021). “In South Africa, 55 million payments to the value of over R80 billion are processed every month” (South African Banking Risk Information Centre, 2022:1). Global financial services are plagued by problems linked to outdated technology that does not keep pace with digital advances, making it slow and unreliable (Chang *et al*., 2020; Tapscott & Tapscott, 2018). Payment problems are caused by multiple, complex interconnected factors (Chong & Diamantopoulos, 2020). Ratheesh and Nair (2021) point out that because of the risks associated with payments, particularly in banking services, there is an increased need for innovation.

Blockchain technology could bring about a major shift within the payments and banking services (Buitenhek, 2016). This 12-year-old technology is rapidly expanding across the globe with Australia, China, Japan, United Aarab Emirates (UAE), Malta, Switzerland, United States of America (USA), Estonia, United Kingdom (UK) and Singapore being the top 10 countries leading this technology (Sharma, 2019). According to Blackduck (2024), blockchain is a smart invention, with no central point of authority. In addition, Blackduck (2024:3) defines blockchain as, “*Blockchain* owes its name to the way it stores transaction data—in *blocks* linked together to form a *chain”.*

Blockchain technology represents itself as a powerful innovation that could change the way people interact online and might serve as the central platform for the payment system between smart technologies (Swan, 2015). Although this may be the prediction of blockchain technology, the execution of the idea is an extremely challenging process (Kuklii & Rudnytska, 2020). When new technology is introduced into any industry, it comes with hurdles and intricacies that affect various areas within an organisation (Janssen *et al*., 2020). Blockchain is still in a premature phase in comparison to traditional databases and would require long-term digital protection as the technology matures (Zīle & Strazdiņa, 2018). The distinctiveness of blockchain is its unalterableness. This poses to be advantageous, but it also highlights challenges for compliance to the European General Data Protection Regulation (GDPR), in the absence of which deployment of blockchain-based financial applications will remain questionable in the European Union (Khan, 2020). The study endeavours to fill this gap by determining the effect of blockchain on payment services that results in enhanced service performance and ultimately leads to better organisational

performance. One of the leading commercial banks in South Africa has been selected as the research site. A qualitative exploratory study was conducted at a Commercial Bank to determine the effect of blockchain technology on payment services.

1.2 Background to the research problem

As of this writing, blockchain technology is a current topic of much research discussion from both an industry standpoint and an academic perspective. The main benefit of blockchain technology is its potential for enhancing security and data integrity, transparency in transactions, and efficiency. There has been a consistent level of research on blockchain technologies as a result of the growing interest in technology globally. This is evident in Figure 1.1 by the number of publications on Google Scholar using search query 'Blockchain' in Google's search engine.

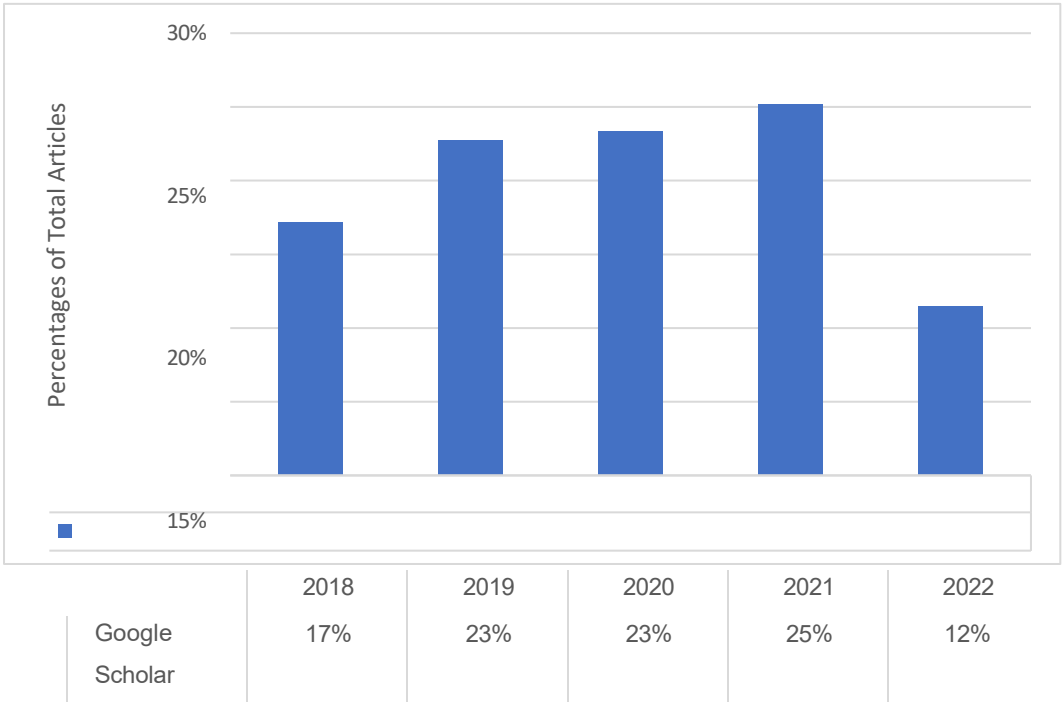


Figure 1.1: Increase in number of scientific articles on blockchain technology from 2018 to 2022 using Google Search Engine

Analysts have projected that blockchain technologies will attain peak adoption over the next five to ten years. They furthermore predict that the business value that will be generated worldwide by blockchain technology will "grow to slightly more than 176 billion US Dollars by 2025 and exceed 3.1 trillion US Dollars by 2030" (Lovelock *et al.*, 2017:1).

A main objective of this study is to explore ways in which organisations can utilise this emerging technology to maximise business value and innovation potential.

1.3 Statement of research problem

According to Pilbauer *et al*. (2019), there was sharp rise in payment volumes in South Africa surpassing one billion transactions between 2002 and 2018. Payment services lubricate the wheels of an economy (PASA, 2019), whilst in the banking industry, it serves as an income generator (Lamb, 2020). Banks face the problem of delays in effecting payment services and cross-border payments, which result in customer complaints (Haile, 2014). Cross-border payments remain slow as a result of correspondent bank involvement (Bech & Hancock, 2020). An added problem is that over the past decade, correspondent banks have fallen by 20% operationally, despite an increase in the volume of payment transactions (Rice & Peter, 2020). Cyber-attacks and fraud have diminished the trust in correspondent banks, resulting in alternative methods being explored in effecting payment transactions (Bayram, 2020).

In reviewing the most recent literature, the application of blockchain technology has become popular in payment services and transactions in international banks in respect of the benefits it offers (Heidari *et al*., 2020; Holotiuk & Moormann, 2019; Halilbegovic & Arapovic, 2019; Taufiq *et al*., 2018). Banks are deemed the pillar of stability in the economy, investigating how the use of blockchain technology can mitigate problems (Kumari & Devi, 2022). From an African continent perspective, Ghana has found the use of blockchain in land registration beneficial (Demuyakor, 2020). Kenya has found value in applying blockchain technology in livestock data management (Muganda *et al*., 2020), electoral validation (Makokha, 2020), and in banking to mitigate financial risk (Fatoki & Wanjagi, 2019). De Meijer (2020) states that blockchain poses challenges related to the implementation of the technology and organisational adoption. Furthermore, the impact of the technology could have consequences on the business model within the banking sector, specifically in respect of payments (Dierksmeier & Seele, 2020). Payments are seen as a profitable income generator, hence losing this service would have catastrophic consequences for banks (Holotiuk *et al*., 2017). Whilst literature indicates that banks are beginning to explore the utilisation of blockchain technology, a lack of strategic coherence is apparent in the adoption of this technology (Ciccaglione, 2019).

Based on the abovementioned, there is a notable gap in studies examining on the effects of blockchain technology on payment services within the South African banking sector. Consequently, banking staff may not be fully aware of the effect and benefits of blockchain, which can add a competitive advantage to their payment services and to the bank as a whole. This study endeavours to investigate the ramifications of blockchain technology on payment services at a selected Commercial Bank within the South African context.

1.4 Aim and objectives

Aligned with the research problem, this study aims to evaluate the influence that blockchain technology may have on the payment services in a South African Commercial Bank. To achieve this, the study planned to realise the following research objectives:

- To identify and analyse the key challenges of applying blockchain technology in the South African banking industry.
- To explore the main benefits of blockchain on payment services in the South African banking sector.
- To assess the effect of blockchain technology on payment services at a South African Commercial Bank.

By accomplishing these objectives, the study endeavours to contribute valuable insights into the challenges, benefits, and overall impact of blockchain technology on payment services, thereby facilitating informed decision-making and strategic planning for South African commercial banks.

1.5 Research questions

Over the past few years, the number of blockchain-based applications has grown significantly, with use cases expanding beyond the payments sector. Blockchain is regarded as having remarkable potential (Tapscott & Tapscott, 2017), and its integration into the payments industry is seen as transformative (Bott & Milkau, 2016). To address the challenges faced by payment services and add value to the South African banking sector, this study aims to answer the following research questions (RQs):

RQ1: What are the key challenges of applying blockchain technology in the South African banking industry?

RQ2: What are the main benefits of blockchain for payment services in the South African banking sector?

RQ3: How does blockchain technology impact on payment services at a South African Commercial Bank?

1.6 Rationale and significance of the study

1.6.1 Rationale

The financial industry as a whole is paying attention to the power of blockchain technology, as it may prove to be a pronounced disrupter to the traditional banking industry (Hayes, 2019). Cross-border payments in traditional banking require the services of a correspondent bank,

which incurs costs, and the execution of the transaction can be delayed (FinExtra, 2019). FinExtra (2019) further explains that blockchain technology eliminates the use of third-party services, thereby reducing costs. However, South African banks are being cautious in adopting the technology (Gray, 2018). Results from the study of Cole *et al*. (2020) highlights that there are limited blockchain experts in the banking field. Brijmohun (2017) concludes that banks are not allocating sufficient resources to progress the adoption of this technology.

The rationale for this study is motivated by the goal to close the gap in interpreting and understanding the implications of blockchain technology on payment services within South African commercial banks. As the financial landscape evolves, and the demands for secure, efficient and cost- effective payment solutions intensify, it becomes imperative to consider the hurdles, and the positive outcomes related to adopting blockchain.

1.6.2 Significance of the study

The value of this research lies in its potential to offer profound insights into the integration of blockchain technology within the context of payment services in South African commercial banks. According to Casey and Vigna (2019), blockchain technology is going to be the future of everything and it will have a significant effect on everybody. Blockchain technology has enabled the digitisation of currency and fast payments (Goncalves, 2020). The outcome of the research hopes to indicate how the selected Commercial Bank should overcome the challenges it faces in respect to interoperability, governance, compliance and integration into legacy architecture by using blockchain technology. The study is intended to contribute insight to the scientific body of knowledge.

The significance of this study extends beyond the immediate scope of the South African banking sector. It has the potential to influence decision-making, operations, innovation and regulatory frameworks, ultimately shaping the future landscape of payment services not only in South Africa but also in other similar economies.

1.7 Research methodology

The research methodology outlined is academic in nature, aimed at enhancing understanding of phenomena regardless of immediate practical applications, while also developing new techniques and procedures (DePoy & Gitlin, 2015). Four objectives guide research studies: descriptive research (to describe phenomena), correlational research (to explore relationships between variables), explanatory research (to explain occurrences), and exploratory research (to investigate less-known areas) (Kumar, 2018). This study adopts an exploratory research methodology to delve into its subject matter.

1.7.1 Research philosophy/paradigm

A research paradigm is defined as a comprehensive framework of ideas, values and assumptions guiding research efforts (Guba & Lincoln, 1994). While literature highlights various paradigms, three primary ones in educational research include the positivist, interpretivist/constructivist and critical/transformative paradigms, with a fourth, the pragmatic paradigm, integrating elements of the others. Each paradigm comprises ontology, epistemology, methodology and axiology, which together influence the research approach (Pruzan, 2016). This study is grounded in the interpretivist paradigm, facilitating an analysis of participants' perspectives and insights.

1.7.2 Research approach or research reasoning

Various reasoning principles are used by scientists and scholars alike to connect premises and conclusions and to support statements in them. Everyday life and science include three forms of reasoning that we use to draw conclusions (Mantere & Ketokivi, 2013), namely, inductive reasoning, deductive reasoning and abductive reasoning. This research follows an inductive approach, which is in line with the interpretivist paradigm. Inductive methods are known to be quite effective; hence they are appropriated for use cases where knowledge is intended to be acquired across various sources (D'Amato *et al*., 2008).

1.7.3 Research strategy/design

Research design outlines the plans and techniques employed to address research questions, with three primary designs: quantitative, qualitative and mixed-methods. These designs are frameworks composed of the techniques used by researchers to address research questions (Kumatongo & Muzata, 2021). Furthermore, Sami Almalki also refers to three research designs, namely, quantitative, qualitative and mixed-methods (Almalki, 2016). Mixed-methods research works primarily within the pragmatist paradigm and uses both quantitative (numeric data) and qualitative (narrative data) research (Teddlie & Tashakkori, 2009). This study utilises qualitative research design, emphasising non-numeric data and narrative analysis to derive insights related to the research questions.

1.7.4 Sampling

Sampling involves selecting participants or situations that yield rich data on the research topic (Moser & Korstjens, 2018). Considering practical constraints, this study adopted non-probability sampling techniques. "Ideally, probability sampling methods should be used to ensure representativeness of the sample and also for generalisability of the results to the target population" (Acharya *et al*., 2013:333). The study adopted non-probability sampling to obtain the targeted sample population. Purposive sampling selects individuals who can provide in-depth information on the research topic, while convenience sampling involves

selecting easily accessible participants. For this research, non-probability sampling is used, and two techniques are employed: purposive and convenience sampling. In purposive sampling, the sample is approached by the researcher, who has a prior purpose in mind as the sample can provide important in-depth information that cannot be obtained from other sources (Alvi, 2016).

1.7.5 Unit of analysis

The term “unit of analysis” (UOA) is commonly used in research and statistics. It refers to the specific entity or subject that is being studied or analysed in a research project. “The unit of analysis is defined statistically as the “who” or “what” for which information is analysed, and conclusions are made” (Sedgwick, 2014). Understanding the UOA is critical because it determines the type of data to be collected and the sources from which the data will be collected (Nayak & Singh, 2015:16).

For this study, the unit of analysis is the organisation, i.e., a Commercial Bank.

1.7.6 Unit of observation

“The unit of observation, sometimes referred to as the unit of measurement, is defined statistically as the ‘who’ or ‘what’ for which data are measured or collected” (Sedgwick, 2014:1). For this study, the unit of observation is the perceptions and experiences of the interviewed individuals.

1.8 Data collection

Data collection is a critical phase involving systematic gathering of information on selected variables. Researchers build their findings on data collected on their own which is called primary data and secondary data, which is sourced from existing literature and previous studies. The evidence collected from research has to be used carefully. Refined data collection offers ways to plan and complete high-value research (Olsen, 2012). Data collection is the process of gathering and measuring information on selected variables in an established systematic manner (Mane & Nikam, 2019:131). For this study, qualitative research employs methods such as small-group discussions and semi-structured or in-depth interviews to gather rich perspectives on the research topic (Hammarberg *et al*., 2016).

1.9 Data analysis

Data analysis is the process of interpreting collected information, transitioning from data collection to a formal analysis stage. It encompasses both objective quantitative analysis and subjective qualitative analysis. Researchers arrive at the formal stage of data analysis after a significant amount of data has been collected during the study (Shkedi, 2019). Data analysis

involves collecting open-ended data and then understanding the information obtained (Creswell & Creswell, 2018). Auerbach and Silverstein (2003) explained that quantitative data analysis is objective, which is consistent with validity, reliability, and generalization theories, while Dey (2003) believes that qualitative data analysis is subjective, which allows researchers to interpret the data and place it in a specific context. “Subjective data means opinions rather than facts, intuition rather than logic, impressions rather than confirmation” (Patton, 2015:1042).

This study employs qualitative data analysis methods, specifically thematic analysis, which involves transcribing interviews, coding keywords, categorising information, and linking themes to research questions for a comprehensive understanding of the data.

1.10 Ethical considerations

This study adhered to the ethical guidelines outlined in the CPUT research ethics policy. The researcher obtained the required compliance certificate as the study could not commence without obtaining clearance from the University Ethics Committee. Participants were invited to take part voluntarily and were asked to sign a consent form, which emphasised their privacy and confidentiality. It was also communicated that as the participation was voluntary, they could withdraw from the study at any time. All shared data and personal information were handled with strict confidentiality and securely stored throughout the research process.

1.11 Contribution of research

This study focuses on blockchain technology by examining the effects it has on payment services in a Commercial Bank. The finding of this research has a double focus: to add depth to existing literature and to offer practical suggestions for implementation as it explores the potential benefits and challenges blockchain might have on the banking payment system. The study further explores the impact of adoption and implementation of a blockchain within a Commercial Bank. The outputs provide future researchers with perspectives related to blockchain technology and offer the selected Commercial Bank with the opportunity of understanding the benefits, challenges and impact of blockchain technology on payment services.

1.12 Thesis layout

Chapter 1 – Introduction

This chapter provides an overview of the research. Based on the problem statement, it gives a background on the application of blockchain technology on payment services in the banking industry. The research questions, objectives and rationale of the study are presented. Additionally, the delimitations of the study and outline of the chapters are described.

Chapter 2 – Literature Review

This chapter defines the key concepts of blockchain application and payment services to establish a sound understanding of the topic. In line with the research aim, the effects of blockchain application on payment services in the banking industry from a broad perspective are explored. The review demonstrates the researcher's understanding of the ideas and findings related to the topic and how the researcher's findings may be different to those of other researchers.

Chapter 3 – Research Methodology

This chapter explains the protocol followed to obtain results, which includes the sources used, the type of data collected from the sources, and how the data was analysed. An explanation is given as to why the researcher's approaches to gathering data might be different from those of other researchers.

Chapter 4 – Presentation of Results

This chapter presents the findings as well as outcomes of the analysis aligned to the research questions.

Chapter 5 – Discussion of Results

This chapter interprets the results related to the research questions, taking into account the different perspectives of relevant literature. The significance and effects of blockchain application on payment services in the selected Commercial Bank are thoroughly discussed.

Chapter 6 – Conclusion and Recommendations

In this chapter, the research questions are answered and the researcher's contribution to the research problem are summarised. Recommendations are made for future studies, focusing on improving other services in the banking industry through using blockchain technologies.

1.13 Summary

This chapter outlined the research through an introduction and background of the topic together with the problem statement, aim, research questions, and research objectives. The research methodology was briefly summarised, with the focus on the data collection, data analysis and ethical considerations.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

A literature-based analysis of blockchain is presented in this chapter. The chosen literature is relevant and credible because most sources are peer-reviewed, and many sources are from the original authors. CPUT avails their library databases to researchers and this study sourced relevant literature from databases such as Current & Completed Research (South Africa), Google Scholar, CPUT Research Outputs, Scopus and DOAJ-Directory of Open Access Journals. The title of the study and the problem statement was used to extract keywords. Literature was explored and interpreted in accordance with the research questions.

Blockchain applications seem to be more prevalent in markets outside of South Africa. At the time of this research, there were far fewer publications specifically dealing with the South African context. Key concepts used when searching for relevant articles include: blockchain, blockchain technology, payments, costs, scalability, interoperability, regulation and compliance. To better comprehend the concept of blockchain in payments services, one needs to reflect on the history of banking and the global financial crisis and then look at the essential features of the technology explained in sections 2.5 to 2.9.

2.2 Blockchain technology application in the banking sector

The employment of blockchain technology in the banking industry, presents a promising solution to tackle various operational inadequacies often associated with traditional systems, such as rigorous security demands, departmental harmonisation and multi-layered processes. By converting to a blockchain technology stack, money transfers and clearing of the funds are streamlined which improves security and system throughput (Deloitte, 2017).

In traditional banking, several departments are involved to process a single transaction which causes delays and slows down workflows (Cai, 2018). This multiple department interaction, results in limited data traceability and increases operational expenses. With blockchain's decentralised infrastructure, these processes can be improved to ensure transparency, speed and decreased operational expenses (Dai & Vasarhelyi, 2017; Eyal, 2017).

Blockchain technology also strengthens data security and improves operational performance using distributed storage systems. For example, multiple nodes records data therefore the dependency on a central source is eradicated, resulting in a robust structure less prone to data loss and system failure (Ravindran & Vamsi, 2021; Alabi, 2017). Furthermore, as multiple nodes are connected to the network, data is open to everyone to

view which promotes a culture of trust between parties (Frizzo-Barker *et al*., 2020).

Central banks worldwide are also exploring blockchain's potential through the development of central bank digital currencies (CBDCs), which is one of the most popular applications of this technology. CBDCs is a digital format of fiat money which could assist the central bank, i.e. Reserve Bank in the case of South Africa to expedite cross border payments, help the country move to becoming more digital and to strengthen the fiscal oversight (Esteva *et al*., 2017). This exploration demonstrates how blockchain can potentially re-design the global flow of money.

Research indicates that financial institutions can reduce missed payments on loans that were issued by implementing blockchain smart contracts in their operational architecture to ensure accuracy and transparency of data (Maryniak *et al*., 2021; Dubey *et al*., 2020). Confidence and accountability are promoted as each transaction is verified and saved on a ledger that is visible to all involved parties (Cai, 2018; Cangemi & Brennan, 2019). Blockchains automated, tamper-proof records can reduce banking regulatory and audit findings, demonstrating adherence to governance (Dale, 2019).

Blockchain technology positions itself as a crucial asset for banks seeking to remain competitive, comply with regulatory requirements, and keep up with client demands in a tech-driven world (Kasturi, 2023; Frizzo-Barker *et al*., 2020). As a cornerstone of the emerging "Internet of Value", blockchain has the potential to reshape the future of financial services profoundly.

2.3 History of financial transactions

There was no physical money thousands of years ago when human beings traded goods and services; instead, a barter system was used instead of monetary exchange (Taskinsoy, 2021b; Reincarnation *et al*., 2010; De Gregori, 1967). Orrell (2016) summarises that the evolution of money has gone through seven key stages, depicted in figure 2.1:

- Barter – commodity money (a commodity serves as a medium of exchange).
- Metallic money – coins used as a medium of exchange made from copper, silver, gold or metal combinations.
- Paper money – bank notes and credit money (line of credit, letter of credit, , revolving business account, loans and cheques).
- Plastic money – pre-paid cash cards, credit cards, retail store cards and debit cards.
- Digital money – electronic money, virtual currency, digital coins, and cryptocurrencies based on blockchain, such as bitcoin.

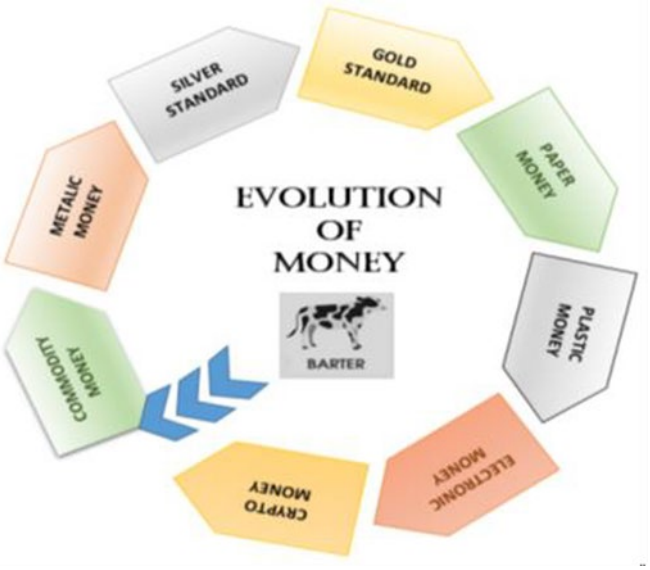


Figure 2.1: Evolution of money (Source: Taskinsoy, 2020)

A growing number of early civilisations were able to engage in trade with other parts of a city, kingdom, or even with other countries (Daychopan, 2016). Treasury departments of ancient cities, and gradually, commercial banks, acted as common and trusted third parties in financial transactions (MacDonald *et al*., 2016).

2.4 The impact of global financial crises

According to Weber (2016), World War I caused numerous countries to abandon the gold standard, and this freed central banks of limitations on the amount of money they could print without being bound by the quantity of gold in their vaults. As per Pilkington (2016), this caused a significant upsurge of unbacked currency in the world. As a result, the world's financial system was at risk of destabilisation.

Commercial banks create money in the modern economy by lending money to consumers or purchasing assets from them. When consumers are given credit (e.g., for mortgages, vehicles, higher education studies, etc.) in the contemporary economy, credit money is generated. Banks are at the forefront of financial intermediation, and no other institution is as effective. As a result, monetary expansion through bank credit has grown dramatically since the 1960s (Taskinsoy, 2021b). When economies are healthy, credit expansion (i.e., money creation) is often welcomed, but excessive money creation has typically led to some of the costliest financial crashes in history, such as the Asian financial crisis of 1997-1998, the subprime debacle of 2006, and the 2008 global financial collapse (Bech *et al*., 2014; Beachy, 2012; Acharya *et al*., 2011; Allen & Gale, 2007; Arrow, 1964).

According to Grosse (2011), the financial crisis also consisted of two key elements:

- Government agencies' failure to adequately regulate the US mortgage market between 2004 and 2007, which led to excessive lending and borrowing.
- Market participants' failure to value financial instruments such as collateralised debt obligations adequately. Because of this, financial institutions created and sold mortgages and mortgage-backed securities with insufficient risk control.

These two elements are referred to as 'inadequate supervision', meaning both the financial institutions and regulators were at fault. The actions caused the erosion of trust in commercial and central banks, and, according to some authors, the entire banking system (Pilkington, 2016). The global financial crisis of 2008 has motivated increased interest in the subject of trust, with the result that trusting banks and other entities in the financial system have been blamed for their failure (Earle, 2009). Abuses of information and communications technologies for surveillance, the spread of disinformation and public coercion have become apparent recently, resulting in a growing lack of trust in governmental authorities and large online platforms such as Facebook, Google and Twitter, which have been involved in such activities (Ryan, 2019; Gallagher, 2019; Gallagher & Greenwald, 2014).

Blockchain technology, particularly, has become a solution to the loss of confidence in traditional institutions and online intermediaries, as blockchain-based systems operating on knowledge of procedural and rule-based processes and founded in mathematical knowledge and cryptographic rules, produce confidence (De Filippi *et al*., 2020).

2.5 The entry of blockchain and bitcoin

An individual's trust in another individual or organisation is the belief that the other person or organisation will act in a beneficial manner even if the trustor is unable to monitor or control that individual or organisation (Mayer *et al*., 1995). Financial intermediaries (e.g., commercial banks) and central banks are involved in establishing trust to ensure that transactions are processed and completed fairly and safely. Individuals and organisations rely on this assurance to ensure a trustworthy experience (Nelms *et al*., 2018).

Nakamoto (2020) cites loss of confidence as one of the reasons for the creation and release of an electronic cryptocurrency called Bitcoin. Crosby *et al*. (2016) explain that blockchain, the technology used to create Bitcoin, attempts to provide an independent payment system and currency that operates outside the banking system to remove the need for (trusted) third parties in a two-party transaction and their attached fees.

The big technology companies, or GAFAM (Google, Amazon, Facebook, Apple and

Microsoft), have recently been making a significant impact on the banking industry, particularly with regard to the areas of payments, lending, saving and investment products. As a result of the arrival of these new market players, traditional banks have been forced to innovate and reposition themselves to remain competitive in a changing digital landscape (Atca Gorgun & Wolfs, 2021).

According to Heires (2016), major corporations have been looking into blockchain technology in recent years. Bank of America has registered 35 patents pertaining to blockchain developments. Amongst others, Citigroup and Barclays are also conducting researching on blockchain technology. The R3 CEV consortium was established by UBS and Goldman Sachs to investigate the feasibility of blockchain technology to lower expenses. The NASDAQ stock exchange and a Visa-backed start-up have developed Linq that utilises blockchain. Blockchain technology has led to fundamental changes the technical frameworks and business models of conventional banks. A Financial Times article (Kharpal, 2017) reports that seven banks in Central Europe have contracted with IBM to create a blockchain-based platform with the potential of improving trade finance. Deutsche Bank, HSBC, KBC, Natixis, Rabobank, Societe Generale and UniCredit used blockchain technology in cross-border trade between small and medium-sized enterprises.

BNP Paribas, UBS, Bank of Montreal, CaixaBank, Commerzbank, HSBC, Agricultural Bank of China, Bank Hapoalim in Israel, Bank of America, National Bank of Dubai, 60 Japanese banks, Bank of England and even the Reserve Bank of Zimbabwe have all shown a keen interest in exploring the application of blockchain technology in enabling payments and transferring of funds (Hassani *et al*., 2018). The European banking industry has undergone a trail of stages in the adoption of blockchain technology, with 2017 being the year of testing and aligning; in 2018 the technology was rolled-out and in 2019 it was implemented (Valverde & Fernandez, 2019).

Thus, blockchain technology has become active projects in banks and other financial houses where their innovation laboratories form part of the broader digital innovation agenda and experiments are carried out in various areas using diverse technologies (Faria, 2021). Therefore, blockchain technology is not perceived as a threat to traditional banks, since renowned banks globally are incorporating blockchain technology into their business models and exploring the technology's potential benefits (Crosby *et al*., 2016).

Table 2.1: Examples of blockchain usage in banking (Source: Kawasmi et al., 2020)

No.	Application Category	Applying Banks	Country	Year	Source
1	Bitcoin trading	Goldman Sachs	UK	2018	(Hassani et al., 2018)
2	Bond transactions	HSBC; State Street Banks	UK; USA	2016	(Shen, 2016)
3	Central banks currency swap cross-border; cross currency using Central Banks Digital Currencies (CBDCs) transfers	Bank of Canada The Monetary Authority of Singapore	Canada; Singapore	2019	(Alexander, 2019; Huang, 2019)
4	Check issuance	Bank of Dubai	United Arab Emirates	2018	(Hassani et al., 2018)
5	Considering the implementation of blockchain technology despite cryptocurrency ban	The Reserve Bank of Zimbabwe; The Central Bank of Jordan	Zimbabwe; Jordan	2019 2018	(The Central Bank of Jordan, 2019; Hassani et al., 2018)
6	Currency funds and order processing	BNP Paribas	France	2015	(Hassani et al., 2018)
7	Experimenting	Bank of America in partnership with Microsoft	USA	2016	(Shen, 2016)
8	Improved KYC	Deutsche Bank HSBC	Germany; UK	2018	(Curry, 2018)
9	Improved settlement	The South African Reserve Bank (settling the country's typical 70,000 daily transactions within two hours with full anonymity	South Africa	2018	(Hassani et al., 2018)
10	Integrating Real Time Gross Settlement (RTGS) systems with blockchain	Bank of England (proposal)	UK	2018	(Hassani et al., 2018)
11	Loan granting	Agricultural Bank of China	China	2018	(Hassani et al., 2018)
12	Remittances	Cross border payments UBS; Santander UK using Ripple remittances competing with SWIFT using Ripple; over 60 Japanese banks (80% of Japanese banking industry)	Switzerland; UK; Japan	2018	(Hassani et al., 2018)
13	Smart contracts	The Commonwealth Bank of Australia	Australia	2018	(Hassani et al., 2018)
14	Trade finance	Using IBM's Batavia Bank of Montreal; CaixaBank; Commerzbank Erste Group Using R3; HSBC Internal trade deals using India Trade Connect; 14 Indian Banks (responsible for around 50% of India's internal trade) including ICICI Bank and Yes Bank	Canada; Spain Germany Central and Eastern Europe UK; India	2018	(Satija & Antony, 2018)
15	Developing blockchain solutions in anti-money laundering, cross-border remittances, assets registry, and loan syndication	Bank for Bajaj Electricals	India	2020	(Sankaranarayanan, 2020)

Research was done on the adoption and implementation of blockchain within an organisation's daily operation with 1,000 organisations throughout seven nations. The following results were highlighted:

- Thirty-four percent (34%) successfully implemented blockchain within their daily operations.
- Forty-one percent (41%) have intentions to implement a blockchain programme within the next year.
- Forty percent (40%) of organisations are planning to use at least $5 million in blockchain proof of concepts in the year ahead (Gupta *et al*., 2021).

The deployment of blockchain has been successful in the following industries: healthcare for health record keeping, real-estate for business record-keeping, managing parking lots, and identification management (Ali *et al*., 2022). Blockchain has stimulated interest among various sectors, such as Healthcare and Welfare, Business and Economy, Education and Innovation, Security and Privacy, Internet of Things and Data Management, Governance and Citizenship, (Idrees *et al*., 2021). Blockchain-based networks allow for the circulation of electricity through "off the grid solar panels" using payment systems operated by blockchain, which will see outdated power grids becoming less important (Nandakumar *et al*., 2021). Blockchain technology today is serving multiple purposes, such as detecting human trafficking and child labour exploitation, curbing corruption and illegal drug trade, releasing music and assuring copyright, sports ticket system, drug testing, and live match streaming (Saha, 2021). In addition, according to industry research, by 2022 the blockchain business will be worth $10 billion, and the business value- add of blockchain will exceed $3.1 trillion by 2030 when it will be in its mature state (Kılıç & Aydın, 2018:1).

2.6 Generations of the blockchain development

2.6.1 Blockchain 1.0 – Digital Currency

According to Efanov and Roschin (2018), the first generation of blockchain, i.e., Blockchain 1.0, originated from the Distributed Ledger Technology (DLT) concept, and the application is built on three layers: (i) the overlying protocol (i.e., transaction enabling software); (ii) the digital currency (i.e., bitcoin or other digital tokens/coins), representing a store of value and providing value to the protocol itself: and the (iii) primary technology framework (i.e., public ledger, hashing and mining).

In the cryptocurrency world, DLT was mostly used to enable direct user-to-user exchanges at minimal transaction fees and partial anonymity. Bitcoin offered trustworthiness, stability, , ease of use, efficiency and independence while maintaining an accurate ledger of transactions (Taskinsoy, 2021a). Along with Bitcoin's successes, it also experienced major setbacks. Proof of work (PoW) is the consensus mechanism employed by Blockchain 1.0, which requires complex mathematical calculations. Since PoW involves complex processes, it takes time and energy equivalent to the profit earned overall (Mukherjee & Pradhan, 2021).

2.6.2 Blockchain 2.0 – Digital Economy

One key emerging use case of Blockchain 2.0 involved smart contracts. Smart contracts are basically computer programs that can automatically formalise and secure terms of a digital contract. Smart contracts provide enhanced management and administration because it is self-executing, which is far more functional than traditional written contracts (Guo & Liang, 2016).

2.6.3 Blockchain 3.0 – Digital Society

Smart cities have the greatest potential for blockchain technology, because features such as smart governance, smart mobility, smart living, resource efficiency, smart citizens, and smart economics are interconnected and they work together (Sun *et al*., 2016). Blockchain 3.0 uses Proof of Authority and Proof of Stake consensus mechanisms so that smart contracts can be processed at a faster pace and with greater computing power, without transactional fees. By using the FFM concept (Fast, Feeless and Minerless), Blockchain 3.0 aims to address the scalability, interoperability, privacy and sustainability problems of former generations. Due to their speed, they can facilitate thousands of transactions in a second, as opposed to previous generations (Mukherjee & Pradhan, 2021). It is worth noting that Blockchain 1.0 was introduced in 2009. Blockchain 2.0 followed in 2010, and Blockchain 3.0 emerged in 2012 (Gupta *et al*., 2021).

2.6.4 Blockchain 4.0

In the future, Blockchain 4.0 is another promising development that will serve as a business operating platform for creating and executing applications. It is anticipated to impart other flourishing machines to blockchain, including artificial intelligence (AI). By using blockchain technology, different platforms can be added in a consistent way under the same umbrella. This ensures constancy to meet both commercial and manufacturing needs. The 4th generation has the prospective to permit transactional speed up to 1 M/sec per transaction (Singh & Vadi, 2022).

2.7 Why the adoption of blockchain technology?

Innovation adoption is defined as the actual utilisation of an innovation by organisational members (Boyne *et al*., 2005:420). Commercial banks and international financial giants are motivated to adopt blockchain innovation for the following reasons:

Firstly, it is cost-effective and reduces value transfers. Commercial banks typically invest copious amounts of money in the purchase and maintenance of centralised databases. Furthermore, bookkeeping adds to labour costs and human operation risks. Decentralised ledgers and blockchain's automation can create low-cost, transparent models without

spending a fortune, thus solving these problems (Nguyen, 2016).

Secondly, it can control risks more effectively. Monitoring and tracking of loan usage is an important aspect of commercial banks' operations, however the task is not as effective as it could be. Furthermore, global regulation of capital circulation can complicate matters. Blockchain technology enables user-to-user transactions between borrowers and lenders who are viewed as nodes, with no need for banks to intervene as intermediaries because of its multi-centred design. Sharing transparent financial information reduces the risk of bad debt and financial management becomes easier (Chang *et al*., 2020).

Finally, it seeks innovative ways to profit. Banks as well as investment institutions are increasingly investing or working with blockchain technology in the financial sector. As banks develop financial products and open markets in this fiercely competitive environment, they must seek innovative revenue models (Chang *et al*, 2020).

2.8 Blockchain unpacked

"Blockchain is the most overhyped, least understood and most disruptive technology of our time" (Floros, 2021: 35). DLT and blockchain are often used interchangeably, but the former is a subgroup of the latter. A blockchain is based on blocks of data that are linked in a linear fashion, adding layers of information one after another that cannot be altered (Padilla *et al*., 2020).

2.8.1 Components of blockchain architecture: How does it work?

Table 2.2: Components of blockchain architecture: How does it work?

Component	Function
1. Node	Client or PC inside the blockchain design in which every node is an autonomous duplicate of the entire blockchain record.
2. Transaction	Any action performed by participants in a blockchain.
3. Block	This component records all the transactions in a sequential manner and ensures that no block has been tampered with. This is safeguarded by using a timestamp for all the transactions when it is added to the chain. Parts that make up a block – the timestamp, previous hash; hash and data.
4. Chain	A succession of blocks in a particular request.
5. Miners	Explicit hubs which play out the block check process before adding anything to the blockchain structure.
6. Consensus (Agreement Convention)	Guidelines and courses of action to complete blockchain activities.

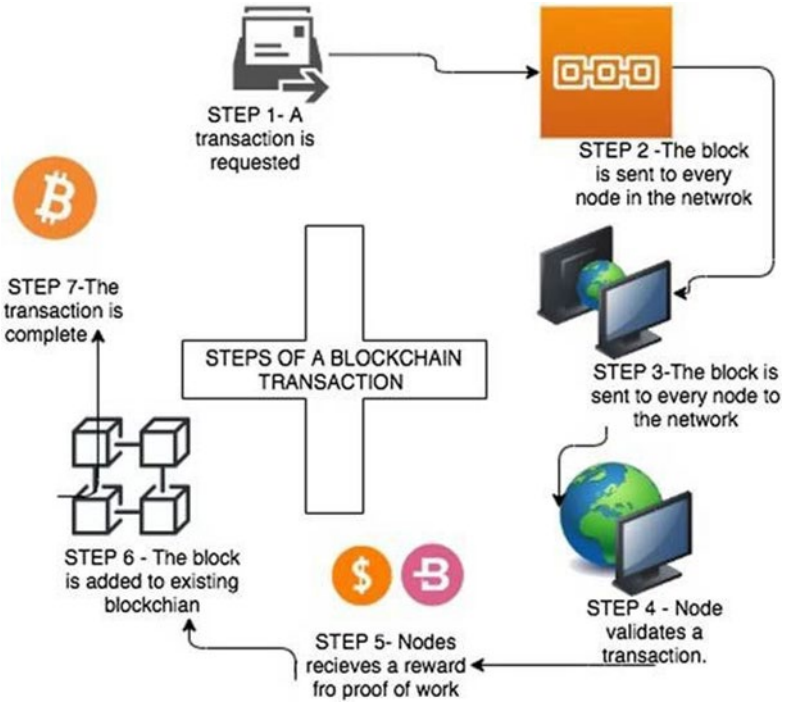


Figure 2.2: Components of blockchain architecture (Source: Alam & Jain, 2020)

2.8.2 Types of blockchains

2.8.2.1 Public/permissionless blockchain

Public blockchains, for instance, Bitcoin, Ethereum, Litecoin and various others, are public blockchains with open access that can be designed by anyone without prior approval. Open blockchains are completely decentralised. Supporters of open blockchains consider the progress to be unbiased, straightforward and responsive (Alam & Jain, 2020).

2.8.2.2 Private/permissioned ledger blockchain

There are two ways to build a blockchain network, either through the construction of a private network or the modification of a primitive network. Sometimes, a few organisations will join forces to build a patent network and share it among themselves to simplify the transaction process. “R3 blockchain consortium” for example, has developed a blockchain system that is used by economic institutes.

The nodes in a permissioned ledger have a certain level of access control in the validation process. As a rule, these nodes are preselected to perform certain tasks. Validation and invitation are required from participants to be part of the network. For example, a particular financial institution must agree on the transactions to be considered valid. Likewise, selected participants can be provided with access to read the block in a blockchain. Primary benefits of private blockchains are quick verification, confidentiality low transaction fees. Permissioned blockchain are utilised by banks. The network has two types of nodes, one

starts, receives and checks transactions, and the other one which can only start and receive the transactions (Upadhyay, 2019).

2.8.2.3 Consortium

Blockchains can be developed in three ways: first, by an individual organisation; second, by a regulator or government body; and third, by forming a consortium. Participants in a consortium blockchain network select their own nodes by which to control the consensus process (Zhao *et al*., 2018). A consortium blockchain combines the advantages of both public and private blockchains, which makes it a hybrid blockchain (Upadhyay, 2019). Literature have distinguished two types of consortia blockchain: technology-focused and business-focused consortia. Technology-focused blockchain aims to design platforms that can be used across different applications and to follow technical rules, while business-focused blockchain technologies are designed to solve specific business problems especially in financial services (Agrawal, 2019; Asuquo *et al*., 2021).

2.8.3 Principles of blockchain technology

Blockchain technology is made up of five key principles (Tapscott & Tapscott, 2018; Iansiti & Lakhani, 2017):

- Transparency with pseudonymity
- Computational logic
- Distributed database
- Peer-to-peer transmission
- Permanent and irreversible records

2.8.3.1 Distributed database

Blockchain functions as both a network and a decentralised database, storing data created within the system. Unlike traditional centralised databases, blockchain's data is distributed across all nodes in the network, with each node maintaining its own copy. Each block in the chain contains a list of transactions, a timestamp, and details about the preceding block. Some blockchains also include additional fields to facilitate consensus mechanisms. This connection to the prior block ensures the blockchain's immutability. If any block's data is altered, its hash changes, thereby invalidating all subsequent blocks in the chain (Padilla *et al*., 2020).

2.8.3.2 Peer-to-peer transmission

"In computer language**,** peer-to-peer is a direct connection between two computers in the same network that can share information without the need for a third computer to have the server function" (Anghelache *et al*., 2020:75).

2.8.3.3 Transparency with pseudonymity

All transactions and associated values are visible to anyone with access to a blockchain. A unique alphanumeric address identifies each user or node (Zheng *et al*., 2018). It is the user's choice whether to remain anonymous or provide proof of identity to other users. Blockchain transactions are traceable, but their identities cannot be revealed (SheCanCode, 2018). This anonymity of digital transactions enables entities to transfer money to any part of the globe without government intervention, and at a relatively low cost (Clohessy *et al*., 2019). However, Zheng *et al*. (2018) argue that although a consortium blockchain has some advantages, it also has limitations, and therefore total privacy cannot be guaranteed. Furthermore, financial institutions in other countries could contravene rulings where regulators have not cleared the transfer of money, especially when transacting cross-border.

2.8.3.4 Irreversibility of records

The nature of a public blockchain is that once a transaction has been entered into the database and updated, it cannot be changed as all historic information has been accounted for (Mahmood, 2021). A chain of records is formed by linking them together. A combination of computational and digital security measures ensures that the records are permanent, chronologically ordered, and visible for all to see (Iansiti & Lakhani, 2017).

2.8.3.5 Computational logic

Digital ledgers enable blockchain transactions to be linked to mathematical formulas and essentially programmed so that users can set up algorithms and rules to perform all necessary operations between nodes automatically (Arora, 2022). For malicious activity like double-spending attacks to be prevented, computational logic requires consensus to ensure legitimacy (Zwitter & Hazenberg, 2021).

2.8.4 Challenges of blockchain technology

In numerous industries, blockchain is still a very new technology. As such, hurdles are slowing down a swift roll-out. Technical concerns such as confidentiality, speed, transparency and scalability requires attention. Legal and regulatory issues are other concerns that have to be managed (Alla *et al*., 2018).

2.8.4.1 Consensus-related challenges

The consensus mechanisms used in blockchain technology often require substantial computational power and energy for real-world transactions, resulting in diminished system efficiency and increased latency. Nevertheless, to support the applications outlined in recent research, blockchain must operate with enhanced and more adaptable capabilities.

Although blockchain technology has reached a relatively advanced stage of development, there remain unresolved challenges in protocol design. For example, improved algorithms are needed for consensus protocols to accurately identify primary nodes from a small pool of trusted nodes. Furthermore, developing a consensus algorithm that minimises network-wide broadcasting while maintaining a fundamental level of security is essential. The overarching goal is to establish optimal protocols that reduce operational time and costs, address competition management, and ensure scalability, performance, identity verification, privacy, and robust protection levels (Sankar *et al*., 2017).

2.8.4.2 Scalability-related challenges

Scalability is not a singular term. Several metrics are involved in measuring scalability, including:

- Block-size – increasing the block size slows done the network time and speed; leads to compromise of proof of work security associated with miners in the blockchain; compromises on decentralisation (Goswami, 2017).
- Network latency – refers to the time allocation to validate a transaction. Network latency should be low to achieve high scalability (Goswami, 2017).
- Other basic scalability issues of blockchain include transaction speed, security, cost, storage capacity, and query inefficiency (Khan *et al*., 2021).

2.8.4.3 Lack of interoperability-related challenges

Interoperability can broadly be understood as the degree to which people, different systems or entities can co-ordinate to reach the same goal (Ide & Pustejovsky, 2010). In the context of blockchain, interoperability means connecting multiple blockchains to share information without compromising its uniqueness and integrity (Wang et al., 2023). This is a main obstacle to dataset sharing across different stakeholders and enabling the connection of applications and services (Dionysopoulos & Giaglis, 2022). Interoperability ranges across four different levels (Di Orio et al., 2022), namely:

- Physical/technical interoperability, which is concerned with the physical connection of hardware and software platforms.
- Syntactical interoperability, which is concerned with data format, i.e., it relates to how the data is structured.
- Semantic interoperability, which is concerned with the meaningful interaction between systems, devices, components and/or applications.
- Organisational interoperability, which is concerned with the way organisations share data and information.

2.8.4.4 Selfish mining-related challenges

Blockchain is more prone to selfish mining-related attacks. Selfish mining is a strategy where malicious miners engage in information concealment by withholding newly mined blocks. This strategy has two main intentions: firstly, to gain an unfairly large portion of mining rewards that is inconsistent to their actual computational input and secondly, to undermine the work of honest miners, causing them to waste resources on ineffective chains (Conti *et al*., 2018).

2.8.4.5 Cost and implementation-related challenges

The underlying cost of implementing blockchain technology, including licensing, can be extremely high. The employment of developers and experts in the field is far more expensive than employing traditional developers (Iredale, 2020).

2.8.4.6 Security, legal and regulation-related challenges

Although the blockchain approach has transformed society in many respects, legal and legislative standards remain debatable. Due to the lack of legal oversight, blockchain has the highlight of various debacles, notably in its initial development phase (Lu, 2019). The more specific the information about the user, the larger the potential of leaking and threatening the user's privacy. If a potential intruder gains access, it would be possible to mine and steal sensitive user data (Himeur *et al*., 2022).

Article 17 of the General Data Protection Regulation (GDPR) clearly outlines the specific circumstance under which an individual has "The Right to be forgotten", this means that you can ask for your personal information to be deleted if it is being used illegally or if it is no longer useful (GDPR.EU, 2022). As blockchain/DLT protocol is irreversible and immutable, this is the biggest challenge for blockchain development, which is particularly relevant to the development of blockchain-based financial services, copyright and content creation and distribution, as well as social media networks (Floros, 2021).

2.8.5 Benefits of blockchain technology

Blockchain technology offers several transformative benefits across various sectors, driven by its unique structure and operational principles. Key benefits of blockchain technology are summarised below.

2.8.5.1 Decentralisation

Cloud computing modes and traditional Internet of Things (IoT) are vulnerable to cyber-attacks as they rely on centralized servers (Habib *et al*., 2022; Atlam *et al*., 2018). Blockchain decentralises data across various computers or devices, maintaining data accessibility and ensuring reliability by eliminating dependency on a central authority. This structure increases

system resilience and reduces data loss (Reyna *et al*., 2018).

2.8.5.2 Enhanced security

In the IoT arena, personal information are in cloud storage such as property details, household items, video footage, personal habits and voice recordings, sparking major security threats (Habib *et al*., 2022). A cloud-system of this nature opens up opportunities for hackers to attack. Adding blockchain technology to cloud computing can help to overcome some of the security challenges (Dorsala *et al*., 2021). Blockchain applies powerful cryptographic methods, which stifles cyber-attack attempts. Every single blockchain transaction is coded and connected to the previous one. This continuous chain protects the data from being hacked and preserves data integrity (Ogunwole *et al*., 2024).

2.8.5.3 Enhanced trust and reliability

Users have great faith in the integrity of the data, because nothing can be amended after information has been verified and stored as transactions, once stored (Saini, 2022). This feature guarantees reliable and secure records, strengthening relationships across sectors (Kumar *et al*., 2022; Rani *et al*., 2021). An admonishment from scholars and experts is that the potential that blockchain offers, may not be a suitable solution for all industries to fix their respective problems (Rani *et al*., 2021).

2.8.5.4 Auditable

Blockchain technology guarantees that all nodes can sight the entire chain of data blocks, ensuring that every transaction is identifiable as blocks cannot be altered without network consensus (Saini, 2022). Liao *et al*. (2022) note that blockchain integration in banking streamlines auditing functions and supports robust identity management. Khadka (2020) emphasises that blockchain's immutability provides a trustworthy ledger, while Garg *et al*. (2021) highlight its potential to optimise resource efficiency.

Javaid *et al*. (2022) assert that blockchain transparency improves access to detailed transaction logs, while Sanyaolu *et al*. (2024) point to its role in broadening equitable financial participation. Cangemi and Brennan (2019) stress that overall, blockchain is a transformative tool for accountability, operational efficiency and compliance in the financial sector.

2.8.5.5 Transparency and traceability

Blockchain generates a real-time ledger 'for-all-to-see' in the payments systems. This visibility builds trust which leads to less chance of dishonesty (Gupta & Gupta, 2020). Blockchain uses an automated program called smart contracts. These programs carry out tasks when pre-set rules are met, similarly to the way a robot operates. The run tasks include

releasing of funds and balance updates (Singh & Ausaf, 2022).

2.8.5.6 Increased efficiency and speed

Liao *et al*. (2022) note that sectors like banking and logistics require high-speed processing. Blockchain improves efficiency through robust identity management and access control. Garg *et al*. (2021) emphasise that blockchain can significantly reduce resources needed for financial audits. Khadka (2020) highlights its potential to revolutionise banking by reducing operational costs. Javaid *et al*. (2022) notes that blockchain executes transactions transparently, securely and quickly all at the same time. Sanyaolu *et al*. (2024) discuss how it broadens financial participation to previously excluded populations. Khalil *et al*. (2022) add that blockchain adoption in the era of Industry 4.0, simplifies financial workflows.

In summary, by using blockchain, the bank will be better equipped to save money, process transactions speedily and optimise day-to-day workflows.

2.8.5.7 Improved privacy and control

As the name suggests, a private blockchain, keeps information private. Whilst it manages access control, it still ensures transparency. Because access control is managed, organisations can balance both disclosure and non-disclosure of information. Liao et al. (2022) emphasises that this function is key in preserving client trust within open banking systems. Khadka (2020) further highlights that blockchain can revolutionise the banking industry by ensuring a verifiable transaction history but also treating confidentiality as a top priority. Khalil et al. (2022) further support this, stating that blockchain adoption in financial services align with the data governance standards of Industry 4.0.

2.8.5.8 Cost reduction

Both supply chain and the banking sector, amongst other sectors are prone to very high transactional fees as third-party involvement adds to the fee structure (Daluwathumullagamage & Sims, 2021). Blockchain banking reduces the fees considerably as record-keeping (duplicate copies held with bank and intermediary) are automated with only one copy held on file (Chowdhury *et al*., 2021; Laurence, 2017).

2.8.5.9 Automation through smart contracts

Smart contracts are stored on a blockchain and as mentioned earlier, they are computer programs that run automatically when specific conditions are met. Conditions such as manual paperwork, identity management and financial audits become automated (Liao *et al*., 2022; Garg *et al*., 2021). This makes blockchain an innovative engine that sparks ideas to make business operations more efficient across different industries Ali *et al*., 2020; Khadka,

2020).

Javaid *et al*. (2022) emphasise smart contracts' role in ensuring that financial transactions are secure and transparent. Sanyaolu *et al*. (2024) discuss how smart contracts makes it possible for more people to have access to financial services. Khalil *et al*. (2022) assert that adopting smart contracts is a smart move for business to stay ahead in this tech-driven era.

In summary, smart contracts enhance process optimisation while addressing the growing demand for automated, secure and efficient transaction solutions.

2.8.5.10 Disintermediation

Blockchain technology removes the middleman. With this removal, trust becomes easier to foster (Sankaranarayanan, 2020; Eyal, 2017). Disintermediation furthermore significantly reduces transactional costs in the (BFSI) – Banking, Financial Services and Insurance sectors (Khatwani *et al*., 2023; Garg *et al*., 2021).

The manner in which accounting methods are currently done, will completely change for the better since blockchain's open and trustworthy ledger makes reporting and compliance easier (Dai & Vasarhelyi, 2017). Its application extends to providing key financial tools to communities who often excluded as well as solutionising social and environments problems (Sanyaolu *et al*., 2024; Mishra & Kaushik, 2023; Khalil *et al*., 2022).). Blockchain not only enables banks to keep in line with client preferences but also plays a key role in driving future financial innovations (Kasturi, 2023; Ali *et al*., 2020).

2.8.5.11 Provenance

Data provenance speaks to the recording of information from the very beginning and any subsequent activity related to that information. Banking records are stored for a limited period of time. However, with blockchain provenance, information can be traced back to its origin and discrepancies can be identified in seconds. Blockchain provenance extends beyond financial assets; it can be applied to any type of data, be it artwork, supply chain, land ownership or even luxury items such as jewellery or precious stones (Maryniak et al., 2021; Sankaranarayanan, 2020).

2.8.5.12 Fast exchange and settlement

Up-to-date information is available to each party involved in a transaction, as the system constantly refreshes data on the ledger (Saini, 2022). Transferring of funds and the settlement thereof are synchronised with blockchain's near real-time processing, which optimises the monitoring of funds done by National Treasury. Additionally, by using blockchain for cross-border remittances, users will be able to negotiate favourable exchange

rates from trading platforms (Gupta & Gupta, 2020).

2.8.5.13 Increased efficiency and speed

Blockchain technology facilitates faster transaction processing in addition to reducing decision-making time across organisations (Zīle & Strazdiņa, 2018). As a result, payments can be processed faster in case of an unfortunate event such as war, floods or an earthquake, among others. Blockchain technology decreases duplicate recordkeeping, minimises reconciliations, and minimises errors and fraud (Laurence, 2017). Transactions can be approved from one location in the blockchain (Risius & Spohrer, 2017). By automating transactions and removing intermediaries, blockchain reduces operational costs and enhances processing speed, benefiting industries that depend on fast, low-cost processing, such as finance and logistics (Daluwathumullagamage & Sims, 2021).

2.8.5.14 Reduced fraud opportunities

Multistep processes are preferred by fraudsters, especially those involving human interaction, such as collateral requirements, currency price conflicts, and foreign exchange mediation. With blockchain, information can be transmitted in real time, thereby reducing fraud opportunities (Ghosh, 2021). In recent years, security gaps in operations have exposed banks to data breaches. The complex cryptographic architecture of blockchain protects it against cyber-attacks (Sneha *et al*., 2021). Blockchain enhances security and reduces fraud attempts as real-time information is recorded oppose to executing multi-step processes involving human intervention (Ghosh, 2021; Sneha *et al*., 2021).

2.8.5.15 Improved compliance

Failure to adhere to prescribed guidelines in the client on-boarding process has resulted in fines, financial losses and reputational damage (Kawasmi *et al*., 2020). Blockchain build and control a ‘Know Your Customer’ repository to ensure that personal customer information is refreshed whenever necessary (Kawasmi *et al*., 2020).

2.8.5.16 Greater financial reach

In many developing nations, blockchain technology empowers banks to provide financial services to the unbanked, people who have struggled to access financial services (Chapiro, 2021). Core financial services, such as applying for credit, making digital payments, saving or diversifying investments can improve people’s lives and financial conditions particularly in volatile economic climates (Daluwathumullagamage & Sims, 2021).

2.8.5.17 Fault tolerance

As technology continues to evolve, maintaining uninterrupted functionality is crucial. Fault

tolerance refers to a system that can continue working even when errors pops up (Egwutuoha *et al*., 2013). In addition, a Byzantine fault tolerant system can continue to operate, provided that if there are not too many malfunctioning parts, i.e., maximum of one third of faulty components (Zivic *et al*., 2019). This attribute ensures that critical processes, such as payment services within a South African Commercial Bank, remain robust and dependable, even when confronted with unforeseen challenges.

2.9 Theoretical frameworks underpinning blockchain technology

Many theories as to how organisations adopt technology have been extensively examined over time, such as Fred Davis' Technology Acceptance Model (TAM), Ewan Rogers' Diffusion of Innovation (DOI) framework, and Tornatzky and Fleischer's Technology-Organisation-Environment (TOE) framework (Bagozzi *et al*., 1992). Innovation Diffusion Theory (IDT) has been applied in the fields of agriculture, communication, the internet, marketing, science, sociology and technology (Argarwal *et al*., 2000; Karahanna *et al*., 1999), but this framework will not be discussed. TAM is aimed at explaining adoption of technology at the individual (end-user) level, while the TOE framework is targeted at organisational level, and the DOI theory incorporates both (De Oliveira Martins & De Oliveira, 2010).

2.9.1 Technology Acceptance Model (TAM)

Taherdoost (2018) explains that TAM identifies three key factors that influence a user's motivation to adopt a technology: perceived usefulness (PU), perceived ease of use (PEOU), and attitude (A), sometimes a fourth factor in included: external variables. Gangwar et al. (2014) posit that TAM is the most popular model for technology adoption, and according to Lee *et al.* (2011) the most conversed model in explaining end-user behaviour; however, Bagozzi (2007) explains that TAM has limitations and may not be suitable for all emerging technologies.

2.9.2 Technology-Organisation-Environment (TOE) framework

The TOE framework asserts that three principle contexts—technological, organisational, and environmental—plays a role in the adoption and acceptance of a new technology (Amini & Javid, 2023). These three principles align with Harker and Zenios' (1999) factors that drive institutional productivity, which are strategy, strategy execution, and environment.

The technological context refers to existing and emerging technologies relevant to the company (Wang *et al*., 2010), as well as how it will be of use to the company (Chiu *et al*., 2017). Furthermore, the organisational context refers to the internal aspects of an organisation that affect adoption, being size, product design, client mix, geographical scope

of business, distribution channel, human resource management, communication processes, and the linking of structures within the organisation (Harker & Zenios, 1999).

The organisational context includes organisational culture, leadership structure, and resource capabilities (Baker, 2012). Furthermore Wang *et al*. (2010), point out that the organisational context also refers to information technology experience, innovativeness, top management support, organisational size, information intensity, and organisational readiness.

Environmental context refers to factors outside of the organisation that can influence adoption. These factors refer to government and regulatory rules, competitive pressures, industry structure and customer demands in which the organisation exists (Lippert & Govindarajulu, 2006).

2.9.3 Diffusion of Innovation (DOI) framework

Diffusion of Innovation (DOI) is a framework that seeks to explain how, why and at what rate new ideas and technology spread (Rogers, 1983). Taherdoost (2018) explains that the DOI framework has four components, namely, model time, communication channels, innovation, and social system, and that components can measure the coverage of a new idea on a global level over time. Taherdoost (2018) further summarises that emerging technologies typically exhibit five core characteristics: its intricacy, its comparative benefits relative to current technologies, its alignment with the organisation's operations and culture, its observability and trialability. Recent studies (Gökalp *et al*., 2022; Lustenberger *et al*., 2021; Clohessy *et al*., 2019) employed the TOE framework in studying the adoption of blockchain in different sectors. These studies have shown that TOE framework considers both the internal dynamics and environmental factors of an organisation.

This current study focuses on the TOE framework, as it facilitates an understanding of the organisation's interpretation of blockchain technology, examines the key drivers affecting adoption and how the organisation thinks about strategies and approaches which can add new ideas to existing literature.

2.10 Summary

The information outlined in the literature review presents some of the research already conducted in the field of blockchain technology. The review identified that blockchain technology exhibits some shortcomings, but overall, the banking sector remains eager to utilise the potential for blockchain to reduce operational expenditure and innovate new profit channels in the future. The fact that major banking players are exploring blockchain is particularly interesting, given that the first blockchain application, Bitcoin, emerged as a

result of diminished trust within the financial sector.

CHAPTER THREE: RESEARCH METHODOLOGY AND DESIGN

3.1 Introduction

Chapter Three discusses the research methodology followed to collate and analyse data for this study. The reviewed blockchain technology literature in Chapter Two has led to the study's adoption of the TOE framework, which was used as foundation to formulate the research questions stated in Chapter One. In turn, the research questions served as a guideline for conducting in-depth, semi-structured interviews with individuals employed by the selected Commercial Bank and who are currently exploring blockchain technology.

Nayak and Singh (2015) explain that the word 'research' refers to a search for knowledge, whilst the word 'methodology' is a plan of action. Kothari (1985) states that research methodology refers to a planned and logical way of investigating and solving a research problem. On the other hand, Crotty (1988) explains that methodology tries to understand the reasons why data is needed, the choice of the data, where it originated from, when it should be gathered and how it should be examined. VanderStoep and Johnston (2009) advise that each plan of action (strategy) has pros and cons; therefore, no single strategy is perfect. The goal of researchers is to select the strategy that delivers the most value at minimal costs (VanderStoep & Johnston, 2009).

3.2 Research philosophy/paradigm

In educational research, Guba and Lincoln define a paradigm as a way of understanding the world, based on how knowledge and evidence perspectives are interpreted (Guba & Lincoln, 1994). In simple terms, a paradigm is an approach to thinking about and doing research (Pruzan, 2016). Candy (1989) suggests that there are three dominant research paradigms applied in educational research, namely, the positivist paradigm, the interpretivist/constructivist paradigm, and the critical/transformative paradigm. However, other researchers such as Teddlie and Tashakkori (2009), propose a fourth pragmatic paradigm that borrows elements from the three paradigms stated above.

3.2.1 Positivist paradigm

Positivism is classified as a traditional standardised approach for assessment and evaluation (Aikenhead, 1997). Positivism stresses "theory verification" (Ponterotto, 2005). Researchers using this paradigm emphasise presenting clear, concrete facts and observable results to explain why certain things happen.

The basic research process is: problem → hypothesis → proposition → verification → conclusion (Xinping, 2002).

3.2.2 Interpretivist/constructivist paradigm

Crotty (1988) states that the interpretivist paradigm describes the process by which humans create meanings as they interpret the world in which they live. Creswell and Creswell (2018) also argue that researchers who use the interpretivist paradigm obtain most of their data from their participants' views regarding the target issues through interaction or discussion. Interpretivist research strives to gain meaningful interpretations from various people across different roles within the workplace (Saunders *et al*., 2019).

3.2.2.1 Critical/transformative paradigm

The critical paradigm seeks to critique societal norms, highlight injustice, challenge dominant value systems and promote social change (Crotty, 1988). Creswell (2007:21) believes that this type of research "should contain an action agenda for reform that may change the lives of participants".

3.2.2.2 Pragmatic paradigm

Pragmatists start with a problem and develops practical solutions for future implementation (Elkjaer & Simpson, 2011). Pragmatists are more concerned about abstract distinctions than practical outcomes, so their research can vary considerably in terms of objectivism or subjectivism (Cunningham & Fitzgerald, 1996). It is a fundamental belief of pragmatists that each person has different ways of interpreting the world and conducting research, that no single point of view can give an accurate account of all the different circumstances, and that there are many different realities (Biddle & Schafft, 2015).

Methodology and methods refer to gathering data required to understand the undertaken study; therefore, most authors focus mainly on positivism and interpretivism because they can be envisioned as the opposites of (i) interpretivists considers personal viewpoints i.e. being subjective while positivists pursue objectivity, and (ii) interpretivists insist in separating the natural from the social world while positivists tend to align their research with natural sciences (Grix, 2019).

For the purpose of this study, an interpretivist paradigm was use. Interpretivism allows researchers to analyse the opinions and knowledge of the contributors (Thanh *et al*., 2015).

3.3 Elements of the interpretivism paradigm

As stated in Chapter One, each paradigm comprises four essential elements, according to Guba and Lincoln (1994) and Lincoln and Guba (1985), namely: (i) ontology, which refers to the nature of reality and what human beings can know about it; (ii) epistemology, which refers to questions such as, "what is the nature of knowledge" and "what is the relationship between

the knower and the would-be known?"; (iii) methodology, which refers to how researcher can go about determining whatever he or she believes can be known; and (iv) axiology, i.e., important ethical aspects to the research were identified and respectfully observed. The elements of the interpretivist paradigm assume the following:

- **Ontology is relative** – meaning that what is being studied has multiple realities, and that those realities, can be understood through close interaction between the researcher and the selected participants (Chalmers *et al*., 2009).
- **Epistemology is subjective** – which means the researcher makes meaning of the data collected from interactions with the participants through his or her own thinking and understanding. It is assumed that the researcher and the research participants engage with each other through dialogue, i.e., questioning, listening, reading, writing and recording research data (Punch, 1998).
- **Methodology is naturalistic** – which means the researcher utilises data gathered through interviews or reflective sessions with research participants (Carr & Kemmis, 1986).
- **Axiology is balanced** – which means that the conclusions drawn will present a comprehensive and impartial report based on the researcher's interpretation of the study (Kivunja & Kuyini, 2017).

3.4 Research approach

Literature provides many definitions of reasoning, however, a simple explanation by Leighton (2004) is that conclusions can be drawn from an initial condition. Everyday life and science include three forms of reasoning we use to draw conclusions (Mantere & Ketokivi, 2013), namely:

- **Inductive reasoning**, which allows students to understand observations, analyse a case study or solve a difficult problem (Michael & Richard, 2013). Furthermore, Hayes *et al*. (2010:278) claim that "inductive reasoning involves making predictions about novel situations based on existing knowledge".
- **Deductive reasoning**, which means progressing from broad to specific details, as in starting with a theory, generating hypotheses from it, testing the hypotheses, and revising it accordingly (Nola & Sankey, 2007).
- **Abductive reasoning**, which is not to develop a general theory, but rather to move from specific observations to specific explanations (Behfar & Okhuysen, 2018).

In essence, deductive reasoning predicts, confirms and disconfirms, while inductive reasoning proposes a possible explanation, and abductive reasoning proposes a plausible explanation (Mantere & Ketokivi, 2013). Any research approach, whether based on inductive,

abductive or deductive reasoning, has to adhere to four rules of being understandable, logical, useful and confirmable (DePoy & Gitlin, 2015).

This study used a Commercial Bank in South Africa as a case study and applied the inductive approach, which is in line with the interpretivist paradigm. With blockchain technology being new in the financial industry, Csapó (1997) states that inductive reasoning plays an important role in understanding science and applying knowledge in unfamiliar situations.

3.5 Research design

3.5.1 Research design types

Research design facilitates the smooth working of many operations. It requires careful planning in the adoption of methods and the implementation of data collection to analyse the research project (Kapur, 2018). Babbie (2008) states that designing a study involves *what* is to be observed and analysed, *why* and *how*. Research design refers to outlines or plans that encompasses various techniques used by researchers to articulate answers to questions (Kumatongo & Muzata, 2021). Sami Almalki refers to three research designs, namely, quantitative, qualitative and mixed-methods (Almalki, 2016).

In quantitative research, the present conditions are described, recorded, analysed and interpreted using quantitative methods. In other words, it refers to processes that can be expressed in terms of quantity and is based on the measurement of amount or quantity (Kapur, 2018).

Qualitative research refers to that which does not use numbers. It uses words, thoughts and images to interpret (Thomas, 2017). Qualitative research looks at the motivating reasons and the approaches adopted in making decisions, rather than concentrating on specific details, timing and outcomes, with the objective to explore, narrate, and interpret the phenomena to try to understand a complicated reality (Creswell, 2009).

Mixed-method research works primarily within the pragmatist paradigm and uses both quantitative (numeric data) and qualitative (narrative data) research (Teddlie & Tashakkori, 2009).

An important factor to consider when choosing a research design is to match the design to the research problem (Creswell, 2002). The intention of qualitative research is to learn from the participant; therefore, open-ended questions are posed so that the researcher can gain insights about a particular idea or phenomenon emerging from participants' perspectives (Creswell & Clark, 2018). Qualitative research allows the researcher to immerse in the culture or organisation being analysed (Trochim & Donnelly, 2016).

This study applied an interpretive qualitative research design, interviewing 16 individuals to help provide more insight into answering the research questions. As blockchain technology is not fully understood within the South African banking environment, the study was both exploratory and foundational.

3.5.2 Research design techniques

An important step in research design is to apply a research technique, and this is dependent on the objectives and expected outcomes of the research (Mane & Nikam, 2019). According to Kapur (2018), four techniques can be applied:

- Exploratory design investigates less understood phenomena and identifies important variables.
- Explanatory design explains the reasons behind the phenomenon and how they are connected.
- Descriptive design documents the phenomenon based on interest.
- Predictive design predicts the overall outcomes of the phenomenon to forecast the events and behaviours.

Hair *et al*. (2020), adds that:

- Exploratory research is used to learn and identify a business problem or opportunity; and
- descriptive research describes a situation by using statistics such as frequency counts or standard deviation.

Literature indicates that blockchain is still in its infancy stage (Zhang, 2020; Kochetkova, 2020; Janssen *et al*., 2020; Jiaying, 2019; Vergouwen, 2018). Moreover, according to Saunders *et al*. (2007), exploratory research is conducted when very little is known about a subject or problem. Therefore, an exploratory approach is appropriate for this study. “It does not aim to provide final and conclusive answers to the research questions but merely explores the research topic with varying levels of depth” (Boru, 2018:3).

3.5.3 Case study as a research strategy

Adelman *et al*. (1976:141) define case study research as “the study of an instance in action”. Furthermore, an advantage of case study research is that it is ‘a step to action’. “Insights may be directly interpreted and put to use for staff or individual self-development, for within-institutional feedback, for formative evaluation, and in educational policy making” (Adelman *et al*., 1976:149). An experiment, history or a case study in most instances employs exploratory research that focuses on *how* and *why* questions (Yin, 2014). Schramm (1971) points out that case studies:

- Explain the assumed casual relationships in complicated scenarios that are difficult to study using other research methods,
- can outline an intervention and the practical setting surrounding its execution,
- can explain certain matters in an assessment, and
- can clarify a situation in which an intervention is being assessed.

3.5.4 Single case vs. multiple case study

Baxter and Jack (2008) suggests that researchers must decide if it is practical to conduct a single case study or if a stronger understanding of the phenomenon will be achieved through conducting a multiple case study. According to Yin (2003), single case studies:

- Can expand existing knowledge and contribute to theory building by validating, contesting or extending the theory, and
- are useful for exploring cases where a researcher has been granted access to study previously unexplored phenomena.

Furthermore Yin (2003) states that single case designs can extend the researcher's entrance to evidence, however, careful investigation is required to circumvent misrepresentation. These studies can be holistic or embedded. An embedded case study involves more than one unit of analysis in the same study, while a holistic case study involves only one.

Multiple case studies, on the contrary:

- Enable researchers to identify differences and similarities between the cases (Baxter & Jack, 2008), and
- can either argue that the results are contrasting for expected reasons, or state that the results are similar (Yin, 2003).

For the purpose of this study, a single case study using a selected Commercial Bank was used.

3.6 Data collection

In any branch of learning, systematic research starts with two main activities. The first is to observe, measure and transcribe the observed details – in other words, data collection. The second (discussed in section 3.6 of this chapter) is to collect and categorise the data so that its significance can be discovered, simplified or explained. As soon as the research problem is defined and the research design is established, data collection begins (Kapur, 2018). Arthur and Nazroo (2003:111), state that "data collection is likely to be less structured in an exploratory study – perhaps in an area about which little is so far known, or if a key objective

is to understand how participants' conceptions or values emerge through their speech and their narrative". Rabianski (2003) explains that there are two methods of collecting data, i.e., primary and secondary data. For primary data, information is collected first hand by the researcher. Furthermore, Gray *et al*. (2007:144), explains secondary data as "building research projects around the analysis or re-analysis of data originally collected by someone else". Primary data collection has two types: quantitative methods - involves numbers and qualitative methods - focuses on thoughts and experience (QuestionPro, 2022). It is common to use the terms quantitative and qualitative methods interchangeably, but the fundamental characteristic of both types of research is that they require naturalistic data (Nassaji, 2015).

There are two main categories of primary data collection methods: those that use numbers (quantitative) and those that explore meanings and experiences (qualitative).

Qualitative data collection methods used in numerous studies are described as follows: open-ended or semi-structured interviews, focus groups, logbooks observations, field notes, documents, photographs, videotapes and audio (Aust *et al*., 2010; Nielsen *et al*., 2007; Creswell *et al*., 2004; Zheng, 2021).

This study used primary data collection where the researcher obtained the data. Since blockchain technology is relatively new in the banking industry, semi-structured questions were used in interview sessions to allow willing participants to share their views freely.

3.6.1 Unit of analysis

A unit of analysis can be any topic being examined, for example, a person, a program, an organisation, a classroom or a clinic (Graneheim & Lundman, 2004). The unit of analysis chosen has consequences for the research design and the faith placed in the results and conclusions (Silverman & Solmon, 1998). Therefore, it is imperative that the researcher understands the unit of analysis as it plays a key role in identifying what type of data should be collected for a study, and from whom it needs to be collected (Nayak & Singh, 2015:16). For this study, the unit of analysis was identified as a Commercial Bank in South Africa.

3.6.2 Unit of observation

This study focuses on a selected South African Commercial Bank, aimed at elucidating the influence of blockchain technology on payment services. The unit of observation comprises individuals directly engaged in the intricate realm of payment services, encompassing staff members, managers and subject matter experts within the centralised foreign exchange division. This division was deliberately chosen due to its pivotal role in facilitating cross-border

transactions and currency exchange.

From the original population of approximately 120 personnel in the centralised foreign exchange division, the study narrowed the scope to encompass approximately 40 individuals intimately involved in executing, overseeing and strategising various payment services. These selected staff members possess a nuanced understanding of the operational intricacies, challenges and opportunities within the payment domain. Noteworthy to the research design is that individuals categorised as administrative staff and personnel from unrelated functional departments have been deliberately excluded. This exclusion ensures that the research's focus remains sharply attuned to those directly contributing to and influencing payment services, thereby enabling a more targeted and insightful exploration of the effects of blockchain technology.

By meticulously defining the unit of observation, this study ensured a concentrated investigation into the nexus of blockchain technology and payment services within the selected South African Commercial Bank. The insights garnered from this refined unit of observation offer a nuanced insight on how blockchain can bring about significant transformation in reshaping the landscape of payment services.

3.6.3 Sampling

"A sample is a set of elements selected in some way from a population" (Schofield, 2006:26), aiming to draw conclusions about the larger population based on the research being conducted (Peersman, 2014). According to Saunders *et al*. (2019), researchers generally use two types of sampling techniques, namely, probability (or representative) and non-probability (or judgmental) sampling. Acharya *et al*. (2013) explain that probability sampling, used by quantitative methodologists, is also known as random sampling whereby everyone in the group has a equal opportunity of being included in the sample. On the other hand, Faizan and Zehra (2016:6) explain that for non-probability (non-random) sampling, used by qualitative methodologists, "each event's selection chances are unequal". Non-Probability sampling is further broken down into different techniques: snowball, volunteer, quota, convenient and criterion/purposive sampling (Vehovar *et al*., 2016):

- Snowball sampling is usually done by using networks. When a researcher has difficulty accessing the population due to their closed nature, contact with a few individuals will encourage others to participate in the study (Etikan & Bala, 2017).
- Volunteer sampling takes place when it's difficult to find participants, in which case the researcher may reach out to volunteers, such as, personal friends, or acquaintances (Singh & Woodrow, 2010).
- Quota sampling is when participants are selected based on specific characteristics

that match those of the wider population (Lance & Hattori, 2016).

- Convenience sampling, sometimes called accidental or opportunity sampling, refers to choosing data sources that are ready availability (Cohen *et al*., 2018). In convenience sampling, the researcher can make contact with a designated person/group that would ordinarily have been challenging (Lynch, 2008).
- Criterion/purposive sampling is precisely what the name suggests. Specific members are chosen who can yield the most value by providing relevant data related to the topic of study (Barglowski, 2018). In purposive sampling, the sample is approached by the researcher, who has a prior purpose in mind as the sample can provide important in- depth information that cannot be obtained from other sources (Alvi, 2016).

Since blockchain is an under-explored phenomenon, future research is necessary to obtain a full understanding of this emerging technology and its implications for the payment services in the banking industry. Phenomenology uses criterion sampling which involves selecting individuals who meet specific criteria, with the most prominent criterion being experienced in the field study (Moser & Korstjens, 2018). This study applied the non-probability sampling technique, and the purposive and convenience sampling methods were employed. A total of 16 experts and professionals, who have experience and knowledge of blockchain but vary in characteristics and in their individual experiences, were selected.

3.6.4 Interview process

Given the prevailing COVID-19 pandemic, the research design incorporated a virtual approach to ensure seamless data collection. Online interviews were conducted via the Microsoft Teams digital platform, providing a secure and convenient avenue for participant engagement. Engagement with participants commenced with a personalised telephonic outreach, where they were courteously invited to participate in the study. Appointments were scheduled at the participants' convenience, emphasising a respectful and accommodating approach to their time constraints.

Upon confirmation of appointments, participants received a comprehensive meeting request. Attached to this request were the interview questions, meticulously tailored to delve into the intricate interplay between blockchain technology and payment services. In tandem, an interview consent form was enclosed, ensuring a transparent understanding of the research's scope, purpose and participant rights. To optimise participation rates, a proactive approach was adopted. A series of follow-up communications, including phone calls and emails, were initiated three days prior to the scheduled appointment. This thoughtful gesture aimed to

underscore the importance of the participants' insights while ensuring logistical preparedness.

Upon initiation of the interview, the researcher acknowledged the significance of the participants' contributions and, in alignment with ethical protocols, formally signed the consent form. Permission to record the audio of the meeting was also diligently sought, underlining the commitment to accurate data capture. Interviews were thoughtfully allocated, with one to two hours per session, allowing for comprehensive exploration of participants' experiences, viewpoints and expertise. This temporal flexibility enabled a nuanced understanding of the intricate landscape of payment services within the context of blockchain technology.

By adeptly navigating the virtual realm and employing a participant-centric approach, this process aspired to yield a tapestry of insights illuminating the transformative effects of blockchain technology on payment services within the South African commercial banking domain.

3.7 Data analysis

According to Schofield (2006), the 'preparation' stage of data analysis is to arrange the data in such a way that it makes sense and that it can be used to answer the research questions. The qualitative data (interviews) were grouped into codes, themes and categories (Wongsuphasawat *et al*., 2019). "The coding process refers to the steps the researcher takes to identify, arrange and systematise the ideas, concepts and categories uncovered in the data" (Given, 2008:85). The following steps were followed for the coding process as outlined by Cope (2010):

- Raw data (audio recording) was transcribed through repeated listening.
- Transcriptions were sent back to the interviewees to validate accuracy.
- Thereafter coding began, which involved reading, re-reading, thinking and re-thinking to develop codes into patterns and themes connecting keywords/key concepts, and looping back to the research questions.

Thematic analysis is a widely used and effective method for analysing qualitative interview data. It involves identifying, analysing and reporting themes or patterns within the data, allowing researchers to delve further and absorb the participants' perspectives and experiences in relation to the effect of blockchain technology on payment services (Vaismoradi & Snelgrove, 2019). Thematic analysis involves the researcher offering a detailed and nuanced interpretation of the data by identifying themes. As an interpretative research method, it heavily depends on the researcher's subjectivity and personal insights to analyse the data and construct meaningful themes.

Since this study endeavoured to explore the effect of blockchain technology on payment services at a selected Commercial Bank, the study adopted a thematic analysis technique as the dataset contained interview narratives. As part of the thematic analysis, each research question is grouped under the objective it directly supports, clarifying the objective's focus on the study's challenges, benefits and overall effects of blockchain technology in the South African banking sector.

3.8 Ethical considerations

Ethics is defined as "norms of conduct that distinguish between acceptable and unacceptable behaviour" (Resnik, 2015: 1). The code of ethics of CPUT was be followed by the researcher. An introductory letter (Appendix A2) briefly outlining the purpose of the research was sent to the organisation requesting access. Thereafter, the informed consent letter (Appendix A3) was sent to the organisation, whereby clarity as to what is expected on their part was confirmed by a returned signed form. The researcher advised each participant that they were allowed to withdraw from the process at any time. This was once again announced before starting the interview process. There were no withdrawals from any of the participants.

MacLean (2013) points out three ethical considerations:

- **Sensitivity** around the topic has to be considered by the researcher through emphasising that the research will be designed to ascertain individual and organisational knowledge concerning the topic.
- Assurance has to be given in respect of the **confidentiality of data and anonymity** of the organisation and individual participants throughout the entire research process i.e., interviews, transcribing, storing and recording information. This demonstrates adherence to the Protection of Personal Information Act 4 of 2013 (POPI) (Republic of South Africa, 2013) and the Bill of Rights Chapter 2 (South African Government, 1996), which enshrine the rights of all people.
- **Research ethics** involves accumulating, processing, storing and analysing data, and then writing up the research findings in a moral way. It is therefore prudent for the researcher to ensure that the "research design is both methodologically sound and morally defensible to everyone concerned".

According to Akaranga and Makau (2016), the following ethical issues should be considered:

- **Advocacy and safety:** The design of a project should not infringe on the rights and safety of the participants.
- **Anonymity, confidentiality and privacy:** The ethnic or cultural background of participants should be kept a secret. Participants should not be referred to by their name, neither should any other sensitive information be divulged. If the information

has to be revealed, consent from the participants has to be obtained.

- **Deception:** The researcher should at all times be completely truthful to the participants.
- **Beneficence:** The researcher has to do good, serving and promoting the welfare of people and avoiding bias.
- **Non-maleficence:** The researcher should not cause any physical or psychological harm to the participants through asking embarrassing questions or forcing participants to divulge information.
- **Voluntary and informed consent:** Whilst a participant may be willing to give their consent, the researcher has to be truthful in explaining the purpose of the study and the risks involved. On this basis, the participant can make an informed decision to participate.
- **Vulnerable groups/special populations:** Should a vulnerable group of the population such as children be involved, consent from parents or guardians needs to be obtained (Akaranga & Makau, 2016).

The above ethical issues, including informed consent, voluntary participation and sensitivity of the topic, were considered by the researcher. The confidentiality of data and the anonymity of the organisation and individual participants were not compromised throughout the entire research process. The researcher followed ethical protocol to ensure that the participants were not exposed to any harm or risk and no questions were asked to deliberately mislead participants. A Compliance Certificate was issued (Appendix A1) after the University's Ethics Committee scrutinised the interview questions to ensure that it was passed the institutional ethical criteria.

3.9 Summary

This chapter presented an overview of the methodology used in this research, which was selected to support the objectives of the research. In this study, the researcher adopted an interpretive paradigm, with the epistemological philosophical stance being subjective. A qualitative research design using inductive reasoning was applied. An exploratory single-case methodology was chosen.

To achieve the aims of the study, 16 staff members within a Commercial Bank were purposively selected to be interviewed. The institutional ethical standards were observed during the research process.

CHAPTER FOUR: ANALYSIS AND FINDINGS

4.1 Introduction

This chapter focuses on the interpretation of the data acquired from the participants, and the presentation of these findings. Sixteen (16) staff members were interviewed. The study aimed to explore the effect of blockchain technology (BCT) on payment services in a South African Commercial Bank, determining how blockchain can possibly enhance competitive advantage, which, in turn, may influence organisational performance. The objectives of the research were to identify the key challenges of applying BCT in the South African banking industry, explore the main benefits of blockchain on payment services in the South African banking sector, and determine the effect of BCT on payment services at a South African Commercial Bank. A non-random convenience sampling method was used to select staff members who were willing to participate in semi-structured interview sessions. The interview questions (IQs) were formulated based on the research questions.

Table 4.1: Research questions, objectives and methodology

Research Question	Objective	Methodology
1 What are the key challenges of applying BCT in the South African banking industry?	To identify the key challenges of applying BCT in the South African banking industry.	Interview Semi-structured questionnaire
2 What are the main benefits of blockchain for payment services in the South African banking sector?	To explore the main benefits of blockchain on payment services in the South African banking sector.	Interview Semi-structured questionnaire
3 How does BCT impact on payment services at a South African Commercial Bank?	To determine the effect of BCT on payment services at a South African Commercial Bank.	Interview Semi-structured questionnaire

The research problem presented, was core to grouping questions into four sets sections. Answers to the semi-structured interview questions provided the data to formulate the findings. The first-hand source, namely the interview transcriptions, were analysed to construct the findings. The data analysis was conducted using the underlying theory that guides the research, ensuring that the findings were contextualised within the technological landscape relevant to the organisation's environment. In line with the POPI Act 4 (2013), participant names and the organisation name are not disclosed. Codes are used to refer to the participants.

Thematic analysis was adopted to interpret the information and present results. When conducting qualitative studies, thematic analysis is a fundamental component that employs a systematic and interactive process to analyse data from semi-structured interview questions (Morgan, 2022).

Thematic analysis is “the process of identifying and analysing patterns within the data to search for themes that are important to the description of the research area” (Hill *et al*., 2022: 293).

Riger and Sigurvinsdottir (2016:35) proposed three reasons for the use of qualitative methods: “(a) Such methods are consistent with the core values of community psychology; (b) they may be used to develop culturally anchored quantitative methods; and (c) they are useful for understanding the subjective meanings that people give to their experience that then give rise to certain behaviors”. Riger and Sigurvinsdottir furthermore stated that “thematic analysis meets all of these criteria”. Thematic analysis offers many different ways to make sense of a dataset, which can be confusing because different researchers have suggested different procedures for conducting a thematic analysis (Finlay, 2021). The different procedures of this method, however, have one thing in common: developing patterns of meaning through a coding process (Braun & Clarke, 2022).

4.2 Data analysis

For the purpose of this study and as recommend by a number of researchers, thematic analysis is a straightforward method for identifying patterns in qualitative data and producing themes that describe these patterns (Braun & Clarke, 2024; Morgan, 2022; Kiger & Varpio, 2020). Based on the procedures of a thematic data analysis, the following steps were followed.

4.2.1 Step 1: Data familiarisation and transcription

To ensure an accurate representation of participants’ responses, all audio recordings were transcribed word for word. The transcripts were reviewed multiple times to thoroughly familiarise the researcher with the data. At the outset of every interview, the purpose of the study was explained to each participant, who was then asked for voluntary agreement to participate. Upon their agreement, the consent letter (Appendix A3) was presented for signing. Once the letter was signed, the researcher proceeded with the interview questions. All sixteen (16) interviews were recorded with participants’ consent. After transcription, the data was returned to the participants to confirm correctness. Once verified, the transcripts were studied and interpreted by the researcher.

4.2.2 Step 2: Initial coding

In this step, open coding was employed as the first step of data coding. Each transcript was carefully read to identify meaningful segments such as sentences, phrases and paragraphs that aligned with the study’s aim, namely, examining the impact of blockchain technology on payment services in a South African Commercial Bank. To enable the researcher to capture

the idea or thought of each response, codes were assigned to these segments to begin with. These codes served as preliminary labels that summarised key points and allowed for easier categorisation and organisation of the data in subsequent steps. The labelling process was exploratory focusing on establishing any repetitive or unique perspectives on blockchain adoption as well as the challenges and benefits in making payment services. This application provided a basis for creating categories in Step 3, gradually forming a structured understanding of the data that unifies with the research objectives. Pertinent themes arose through the initial coding process which was the preparation for tweaking themes and developing more detailed insights.

4.2.3 Step 3: Code generation and collation

A broad list of codes was drawn up after the entire dataset was re-assessed. These codes were then organised into preliminary categories, grouping related ideas to facilitate the emergence of themes. Key concepts from the interviews were identified and coded, as illustrated in Table 4.2. Through a process of refining and collating similar codes, initial categories were developed, eventually leading to the formation of four primary themes. These themes encompass major concepts pertinent to the study's objectives and key questions.

Table 4.2: Key concepts, associated codes and connection for analysis

No.	Key concept	Code	Connection for Analysis
1	Factors influencing the exploration, adoption and implementation of BCT	FI1	Determining factors that drive the exploration of BCT, assessing the significance of BCT in the organisation, examining its holistic impact and recognising finance as a key deciding factor.
2	Perceived benefits of BCT	PB1	Exploring the advantages of implementing BCT, including collaborative benefits, scalability, financial impacts (e.g., reduction in operational costs), and optimisation or efficiency gains.
3	Perceived challenges of BCT	PC1	Identifying challenges such as compliance, governance, regulatory requirements, organisational inertia, collaboration barriers, and cultural change within the organisation.
4	Perceived risks of BCT	PR1	Recognising risks, including reliance on legacy systems, and assessing the transparency provided by a unified ledger to mitigate disputes and support accountability

Each related code was grouped from the findings of the data, resulting in the identification of four key concepts. These concepts reflect core ideas provided by participants and align with the study's research questions (RQs) and interview questions (IQs). Table 4.2 outlines these key concepts, associated codes and their roles in the data analysis, while Table 4.3 links these concepts to specific research questions and provides relevant participant responses.

Table 4.3: Key Concepts linked to research questions and participant response

Questions	Code	Key Concept	Participant Response
(IQ) What were the motivating factors that encouraged the exploration/ acceptance/use of the technology?	FI1	Factors influencing the exploration/acceptance/ implementation of BCT	P10: "Understanding how the evolving landscape of technology impacts financial services. The disruptive potential of blockchain in finance sparked interest in its exploration".
(RQ) What are the main benefits of blockchain for payment services in the South African banking sector?	PB1	Perceived benefits of BCT	P14: "Significant infrastructure savings are possible due to decentralising payment processes, which can streamline operations and reduce costs".
(IQ) How does the Bank address interoperability challenges to allow blockchain systems to operate outside silos and exchange data?	PC1	Perceived challenges of BCT	P1: "We built a custom API layer to enable integration across silos, allowing seamless interaction across various systems and channels through API nodes".
(IQ) What are the risks for the Bank when performing payment services?	PR1	Perceived risks of BCT	P12: "The transparent ledger reduces disputes since everyone has visibility into a single version of truth, which lowers risk exposure".

In this step, the four main concepts were integrated into broader themes, helping structure the thematic analysis around challenges, benefits, factors driving adoption, and potential risks. The identified themes align closely with the study's objectives, presenting a clear framework to comprehend the effect of blockchain technology on payment services in the South African banking sector. This process sets the stage for further analysis and thematic development in subsequent stages of research.

4.2.4 Step 4: Category and theme identification

After analysing all interview responses from the participants, 86 distinct findings were identified. Using a data analysis tool, these findings were initially grouped into 17 categories (see Table 4.4). These categories represent recurring concepts and critical areas that surfaced from the interviews, highlighting the key elements in adopting and implementing BCT within payment services.

Further analysis of these categories led to the identification of core themes that encapsulate the overall findings of the study. The themes provide a framework to understand the primary aspects influencing blockchain adoption, addressing both opportunities and challenges. Each theme explores a unique dimension of BCT adoption in payment services, aligning with the study's research objectives to uncover the challenges, benefits and overall effects of BCT in a South African Commercial Bank.

Table 4.4: Categories

Categories
Efficiency
Compliance Governance Regulation
Cost Efficiency
Innovation Management
Environmental Sustainability
Risk Mitigation
Collaboration
Business Model Enhancement
Technology and Innovation
Intermediary Elimination
Market Intelligence
Internal Processes
Change Management
Improved Information System/Transparency
Scalability of Technology
Blockchain Use Cases and Applications
Interoperability

Objective 1: To identify and analyse the key challenges of applying blockchain technology in the South African banking industry.

- **IQ1A**: When did the Bank consider exploring/adopting/starting to use blockchain technology?
- **IQ1B**: Did the organisation have a clear technology strategy, and how did it align with the Bank's overall strategy and culture?
- **IQ1C**: What were the motivating factors that encouraged the exploration, adoption, and use of blockchain technology within the Bank?
- **IQ2A**: What are the main challenges of adopting blockchain technology (BCT) for payment services within a South African Commercial Bank?
- **IQ2A1**: How did the South African Commercial Bank plan to overcome the challenges related to adopting BCT for payment services?
- **IQ2B**: How can blockchain technology strengthen data privacy in financial transactions, given strict South African legislation and banking governance on data privacy and security?
- **IQ2C**: What is the challenge of interoperability, and how does the Bank apply protocol to enable blockchain economies to operate outside silos and transfer files between each other?
- **IQ2D**: What types of risks could the Bank encounter by transitioning to BCT?

- **IQ2E**: How would blockchain technology impact the integration of legacy architecture and new business models?
- **IQ2F**: How would blockchain technology assimilate into the current technology stack?
- **IQ2G**: How would blockchain technology onboard historical transactional (analogue) data and merge it with current data?
- **IQ2H**: How does the Bank address the issue of blockchain's high energy consumption while considering environmental impact?
- **IQ2I1**: Does the Bank have sufficient technical expertise, i.e., IT staff and banking staff, to manage blockchain technology?
- **IQ2I2**: What is the impact on the Information Technology (IT) staff complement?
- **IQ2I3**: Does the Bank require its banking personnel to undertake a steep learning curve to understand blockchain technology?
- **IQ2J**: What obstacles do management face in respect of transitioning to blockchain technology, considering that change inevitably poses challenges?

Objective 2: To explore the main benefits of blockchain on payment services in the South African banking sector.

- **IQ3A**: How can blockchain technology add more value to enhance income generation for the Bank?
- **IQ3B1**: How can blockchain technology reduce costs for the Bank in effecting payments with respect to peer-to-peer (P2P) transactions?
- **IQ3B2**: How can blockchain technology reduce costs for the Bank in effecting payments for international and cross-currency transactions?
- **IQ3B3**: How can blockchain technology reduce costs for the Bank in record-keeping of transactions?
- **IQ3C2**: In what ways does blockchain technology provide a competitive advantage to the Bank in the financial sector?

Objective 3: To assess the effect of blockchain technology on payment services at a South African Commercial Bank.

- **IQ3C1**: Would blockchain technology provide the organisation with a competitive advantage in the financial sector?
- **IQ3C2**: In what ways does blockchain technology provide a competitive advantage to the Bank in the financial sector?
- **IQ4C**: The time delay in cross-border and cross-currency payments is still

challenging. How can blockchain make payment services more seamless?

- **IQ4E:** How does blockchain prevent fraud in doing payments?

4.2.5 Step 5: Theme naming

In today's rapidly evolving financial services landscape, BCT stands out as a transformative force with the potential to fundamentally reshape the operation and perception of payment services. The integration of BCT into this sector offers the promise of revolutionising various aspects, from enhanced security and transparency to improved efficiency and cost savings. This section presents key themes and defines essential aspects of BCT adoption within payment services, examining specific dimensions that align with critical variables. Each theme explores unique opportunities and challenges, shedding light on the complexities and the promising gains of applying blockchain technology in the financial services industry.

Each theme was derived from the objectives of the study:

- **Theme 1:** Challenges are linked to Objective 1, which identifies and analyses the key challenges of applying blockchain technology in payment services.
- **Theme 2:** Benefits are linked to Objective 2, which explores the main benefits of blockchain in payment services.
- **Theme 3:** Effects are linked to Objective 3, which assesses the effect of blockchain technology ion payment services.

Table 4.5: Themes and sub-themes

Theme	Sub-themes
1. Challenges of Blockchain Technology in Payment Services	1.1 Regulatory Compliance
	1.2 Data Privacy Concerns
	1.3 Legacy System Integration
	1.4 Change Management
2. Benefits of Blockchain Technology in Payment Services	2.1 Cost Reduction
	2.2 Income Generator
	2.3 Cross-Border Efficiency
	2.4 Competitive Advantage
3. Effects of Blockchain Technology in Payment Services	3.1 Operational Efficiency
	3.2. Customer Experience
	3.3 Transaction Transparency
	3.4 Fraud Prevention

4.2.6 Step 6: Charting and mapping

During this stage, this study utilised a thematic map to visually represent relationships between the primary themes and sub-themes, directly aligning with the research objectives

of identifying challenges, exploring benefits, and assessing the impact of blockchain technology on payment services in the South African banking sector. The thematic map serves as an essential visual aid, organising and categorising data within the identified themes to clarify blockchain technology's effects in this context. The thematic map structures the data into three main themes—*Challenges*, *Benefits*, and *Effects on Payment Services*—each comprising specific sub-themes that reflect the study's research objectives:

- **Challenges:** Representing the first research objective, this theme includes sub-themes such as regulatory compliance, data privacy concerns, legacy system integration, and change management. Each sub-theme is connected by arrows to highlight dependencies or interactions such as how regulatory compliance affects data privacy concerns, and both influence legacy system integration.
- **Benefits:** Addressing the second objective, this theme explores the main benefits blockchain technology can bring to payment services, including cost reduction, income generation, cross-border efficiency and having a competitive advantage. Links between benefits illustrate where one benefit may amplify another. For example, improved transaction speed and enhanced record keeping of transactions contribute to customer satisfaction.
- **Effects on payment services**: This theme aligns with the third objective, assessing blockchain's specific effects on payment services within the selected Commercial Bank. Sub-themes under this category include operational efficiency, customer experience, transaction transparency, and fraud prevention. Arrows demonstrate how challenges like legacy system integration may affect the operational efficiency sub-theme, while benefits such as cross-border efficiency directly enhance customer experience and transaction transparency.

From the thematic analysis, three themes and 12 sub-themes were derived. Figure 4.1: Mind-map Figure 4.1illustrates each theme with its corresponding sub-themes and participant outcomes.

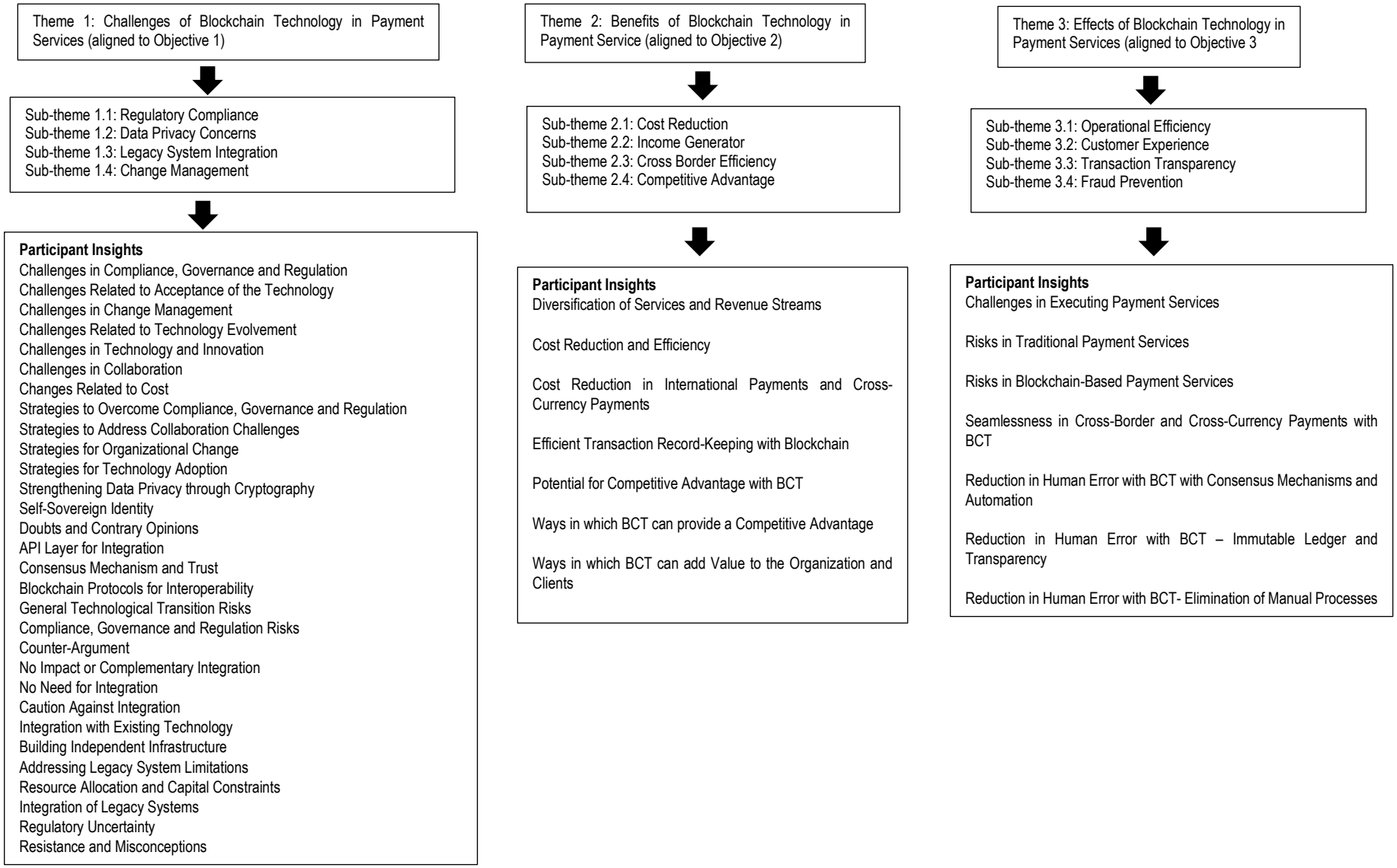


Figure 4.1: Mind Map

4.2.7 Step 7: Data interpretation with participants' quotes

Table 4.6: Profiles of the interviewees

Participant	Department	Job Title
P1	Business & Digital Enablement	Head
P2	Advanced Development Programmes	Developer
P3	Blockchain Innovation	Software Engineer
P4	Channels Enablement	Head
P5	Global Markets Digital Solutions	Analyst
P6	Blockchain Innovation	Developer
P7	Blockchain Innovation	Analyst
P8	Blockchain innovation	Analyst
P9	Business Enablement	Lead
P10	Blockchain Innovation	Developer
P11	Operations	Head
P12	Business Accelerate	Head
P13	Blockchain Innovation	Engineer
P14	Blockchain Innovation	Engineer
P15	Blockchain Innovation	Developer
P16	Operations Corporate	Head

The participants expressed their view/understanding of the challenges, benefits and risks in respect of the adoption and implementation of BCT, which has been supported with quotes from the transcripts (Appendix C). The interpretations of the quotes, exemplify each insight presented below.

Interview Question 1A (IQ1A): The Bank has made advancements and investments in their digital capabilities; hence it is evident that it is open to exploring new technology. Since BCT is relatively new, ±13 years, when did the Bank consider to explore/adopt/ start using it?

Focusing on when the Bank began exploring and adopting BCT and whether this technology aligns with the Bank's advancements in digital capabilities, the following insights were identified from the participants' responses through thematic analysis:

- **Emergence of interest (timeline):** P1 mentioned that the Bank's interest in blockchain technology began to emerge around 2017/2018, with a small number of people initially getting involved. P7 provided evidence of early involvement in blockchain experimentation as far back as 2017 or possibly even earlier, with participation in a Proof of Concept (POC) project called Khokha.
- **Transition to serious consideration:** P6 noted that while there was exploratory engagement with blockchain, serious considerations started around 2018,

coinciding with the initiation of projects like Khokha.

- **Partnerships and collaborations:** P3 highlighted that from 2018 to 2019, there was a particular focus on blockchain, especially in collaboration with the Industrial and Commercial Bank of China (ICBC). This alliance aimed to address problem resolution and to identify specific use cases. P7's involvement in the Khokha project signifies the Bank's undertaking in establishing teamwork related to blockchain.
- **Maturation and production:** P3 mentioned that since 2019, blockchain use cases have evolved to the point where the application has been launched with a limited number of clients using it.
- **Long-term involvement:** Based on P7's comment, it is evident that the bank has maintained consistent interest and involvement in exploring the technology as participation has been ongoing since 2017.
- **Alignment with digital advancements:** Whilst there is no precise wording from participants, their responses indicate that the Bank is receptive to explore new technologies which aligns with its digital transformation journey.

In summary, the thematic analysis revealed that around 2017/2018, the sparked interest in blockchain technology stimulated experimentation which led to building strong synergies. The Bank's transition to serious consideration and the maturation of blockchain use cases occurred in subsequent years, with clear evidence of partnerships and long-term involvement. This timeline suggests that the Bank's engagement with BCT aligns with its broader advancements in digital capabilities, demonstrating its openness to exploring new technologies.

Finding 1: The Bank started exploring BCT about seven years ago around payments and letters of credit.

Finding 2: About five years ago BCT has gone live in certain areas of the banking operation.

Interview Question 1B (IQ1B) focuses on whether a clear technology strategy is in place within the organisation and how it aligns with the Bank's overall strategy and culture. Through the thematic analysis, the following insights were identified from the participants' responses:

I. Perceptions of technology strategy:

a) Absence of a clear technology strategy: P1 expressed the view that there is no technology strategy in place, suggesting a perceived lack of direction or clarity in the Bank's approach to technology.

b) Clear vision but lacking technology strategy: P2 acknowledged the presence of a clear vision for the Bank's digital future but suggests that a specific technology strategy may be lacking.
c) Emerging or developing technology strategy: P3 noted that while blockchain is top of mind in various areas, there is not a clear driver mandating blockchain as a key component of the Bank's technology landscape. However, they anticipate that this may mature in the future.

II. Evidence of a technology strategy:

a) Confirmation of a technology strategy: P6 asserted that the Bank has a serious strategy in place, primarily centred on leveraging big tech and fintech partnerships.
b) Evolution of strategy with learning: P9 confirmed the existence of a technology strategy and highlighted that it has evolved over time as the Bank learned more about blockchain, aligning with their objective of early involvement.
c) Strong belief in blockchain as a key enabler: P13 provided strong support for the presence of a technology strategy, particularly focused on digitisation and blockchain. Emphasis was made on blockchain's potential to propel the Bank into a new technological era and address legacy system challenges.

III. Alignment with organisation strategy and culture:

a) Alignment with strategic goals: P13 highlighted that the Bank's strategy includes a strong belief in blockchain's ability to enable the Bank to achieve its goals effectively. They emphasise blockchain as a technology capable of addressing existing business challenges.

In summary, the thematic analysis revealed mixed perceptions regarding the presence and clarity of a technology strategy within the Bank. While some participants suggested that a clear technology strategy may not be in place or that it is still evolving, others firmly asserted the existence of a technology strategy that has evolved over time.

Additionally, there is evidence of alignment between the technology strategy and the Bank's strategic goals, with a strong belief in blockchain as a key enabler of the Bank's digital transformation efforts, as indicated by P13. The overall findings suggest varying perspectives on the Bank's technology strategy, with some participants confirming its presence and alignment with the Bank's vision, while others express uncertainty or anticipate its development in the future.

Finding 3: Whilst the Bank has an organisational strategy in place, some participants felt that there is no clear technology strategy in place.

Finding 4: Other participants argued that there is a technology strategy in place because of the changing landscape of technology.

Finding 5: There is definite innovation and technological boundary-pushing to enable future readiness through technology implementation to ensure inclusive and sustainable technological advancement within the Bank.

Interview Question 1C (IQ1C) investigates the motivating factors that encouraged the exploration, adoption and use of blockchain technology within the Bank. The following key insights were identified from the participants' responses:

I. Motivating factors:

a) Digitisation and efficiency: An important case for blockchain stated by P3 is the digitisation of documentation as this would be beneficial across multiple banks but more importantly, to streamline processes which ultimately enhances efficiency.
b) Market knowledge and speed: P5 felt that gaining a better understanding of possible speedy settlement of transactions and improved record-keeping on a blockchain, can improve market insights which drives exploration.
c) Competitive advantage and adaptation: P6 placed emphasis on embarking in new business models to prevent stagnancy. Remaining competitive and resilient in a continually changing world motivates exploration.
d) Learning and innovation: P1 highlighted a motivation to learn new things and influence potential changes in the business model. The desire for innovation and exploring new technologies is a significant motivating factor.
e) Business logic and smart contracts: P15 noted that blockchain's ability to encode business logic into smart contracts makes it an attractive choice for many banking projects.
f) Disruption and potential: Since blockchain is perceived to be a game-changer, P10 mentioned its exploration is a huge motivation to understand its disruptive ability in the banking industry as a whole.
g) Boundary-pushing and reputation: P12 expressed that by exploring the technology, the Bank can be motivated to expand their innovation strategies.
h) Awareness of cryptocurrency: P13 drew attention to the importance of exploring the underlying technology to better understand cryptocurrencies.

i) Risk assessment and collaboration: Businesses are exposed to risk which was a motivating factor for P7 to explore how the technology could possibly assist the business in better managing and reducing risk Another motivating factor for P7 was to team up with blockchain partners to brainstorm risk management.
j) Cost efficiency: Participants (P2, P5, P6, P12, P15, P16) highlighted cost efficiency as a leading factor to exploring how the technology can reduce transaction costs and back-end functions.
k) Transparency and trust: Participants (P6, P8, P11) mentioned that the ability of blockchain to create a central data repository, is a motivating factor to explore how it can build trust and transparency.
l) Inevitability and future preparedness: P8 foresees blockchain as the approach in managing the Bank's data. Gaining foresight is the motivation to enable the Bank to adapt to future changes.

In summary, the thematic analysis unveiled numerous motivating factors which are propelling the exploration and approval of blockchain technology within the Bank. These factors include the aspiration for learning and innovation, optimisation, market knowledge, competitive edge, risk assessment, future readiness, the potential for disruption, boundary expansion, well-informed of cryptocurrencies, smart contract abilities, cost efficiency and the importance of trust and transparency. The combination of these factors reflects a multifaceted approach to blockchain adoption within the Bank.

Finding 6: The motivating factors that encouraged the exploration of blockchain technology were to learn new things so that the Bank has an understanding of how the wall of technology is changing and not get left behind.

Finding 7: The use of BCT has the potential to change the business model and business performance.

Finding 8: The use of BCT in respect of payment services definitely improves the Bank's bottom line by decreasing costs and improving efficiencies.

Finding 9: It is important for the Bank to be aware of what the market could possibly be aware of.

Interview Question 2A (IQ2A) explores the main challenges of adopting BCT for payment services within a South African Commercial Bank. The following insights were identified from the participants' responses:

I. **Challenges in compliance, governance, and regulation:**

a) Uncertainty in regulatory environment: P6 pointed out that blockchain regulation within the financial sphere is undefined which poses a huge challenge in successful adoption.

b) Resistance to regulatory change: P8 mentioned that it is very difficult to persuade regulatory bodies to relinquish traditional practices, thus the resistance to embrace new technology becomes very challenging.

c) Compliance as a persistent challenge: P15 emphasises that keeping pace with compliance changes remains an ongoing challenge in the adoption of blockchain for payment services.

d) Regulatory reporting infrastructure: P3 pointed out the importance of having the right regulatory reporting infrastructure in place, suggesting that the absence of such infrastructure can be a challenge.

e) Complex and evolving regulatory laws: P12 noted that opportunities within organisations to innovate are negatively affected due to increased regulatory complexity year on year.

II. **Challenges related to acceptance of the technology:**

a) Fear of the unknown: P1 mentioned to reframe perspectives is challenging, highlighting the importance of organisation transformation.

III. **Challenges in change management:**

a) Adoption timing and caution: P16 suggested that banks in South Africa tend to adopt a ‘wait-and-see’ approach between themselves, instead of being the fore-runner to experiment and implement new technology that could possibly affect all banks.

b) Mindset change: P12 mentioned the challenge of changing the mindset to break away from traditional ways of doing things, highlighting the need for cultural and organisational change.

IV. **Challenges related to technology evolvement:**

a) Integration complexity: P7 noted that integrating new technologies becomes challenging when working with newer technologies, indicating potential complexity in the integration process.

b) Immature technology: P4 and P6 expressed concerns about the relative immaturity of blockchain technology, which can be a challenge in adoption.

V. Challenges in technology and innovation:

a) Complex legacy systems: P15 and P16 highlighted that complex legacy systems within banks, stand in the way of experimenting disruptive technology.

b) Lack of technical and business understanding: P11 pointed out that the alignment of technical and business understanding is challenging but that it is imperative to enable successful adoption of the technology.

VI. Challenges in collaboration:

a) Need for collaborative partnerships: P12 emphasised that blockchain adoption requires collaboration and participation from partners in a network, indicating that unilateral adoption may not be effective.

VII. Challenges related to cost:

a) Cost of implementation: P15 mentioned that the implementation cost to render innovative technology for full-scale production deployment, is a huge challenge.

In summary, the thematic analysis revealed multiple challenges faced by the South African Commercial Bank in adopting BCT for payment services. These challenges span compliance, governance and regulation; acceptance of the technology; change management; technology evolvement; technology and innovation understanding; collaboration; and cost factors. Tracking these issues will be vital for the successful integration of blockchain technology into the Bank's payment services.

Finding 10: Compliance, governance and regulation from a South African perspective as well as from a global perspective is a huge challenge in the adoption of BCT in payment services.

Finding 11: The acceptance of BCT to certain levels of management is challenging because of fear of the negative aspects around the technology, especially cryptocurrencies.

Finding 12: The Bank seems fearful of exploring and would rather wait for others to test the BCT technology.

Finding 13: Between the technical and business teams, there appears to be insufficient awareness of the benefits blockchain technology can bring to the business.

Finding 14: The current payment infrastructure is based on decades-old technology, which is complicated and challenging to merge with newer technology.

Finding 15: Partnership with other entities is lacking, which is preventing the organisation from accelerating innovation and the delivery of powerful digital services that BCT offers.

Finding 16: Implementation on a production level scale is very costly.

Research Question 1 (RQ1) explores how the South African Commercial Bank plans to overcome the challenges related to adopting BCT for payment services. Through the thematic analysis, the following insights were identified from the participants' responses:

I. Strategies to overcome compliance, governance, and regulation challenges:

a) Engagement and control building: P13 indicated a strategy of connecting and working with regulators to set boundaries and construct control measures to establish levels of comfort to compliance with national laws.

b) Rigorous evaluation: P15 mentioned conducting rigorous evaluations of blockchain technology and products to ensure that both internal and external regulatory requirements are met.

c) Regulatory reporting infrastructure: P3 suggested that the Bank plans to improve the regulatory reporting infrastructure, which can make compliance with regulations better and easier.

d) Close collaboration with regulators: P5 and P6 emphasised the importance of working closely with regulators and staying engaged with them. The Bank aims to build a cooperative relationship with regulators from various countries and institutions.

II. Strategies to address collaboration challenges:

a) Blockchain network participation: P11 stressed the necessity of partners to join the blockchain network. The Bank plans is working on strategies to partner with Stanbic in both Kenya and Nigeria.

b) Expanding the ecosystem: P12 is of the opinion that the approach of collaboration, is a tool to overcome challenges by joining forces with companies of one mind to expand the network.

c) Identifying partners: P9 highlighted that since the Bank is focused on closely working with like-minded companies, it is imperative to identify suitable partnerships from the start.

III. Strategies for organisational culture change:

a) Cultural change: P7 recognised a shift in mindset amongst staff as well as a cultural change within the organisation are factors that needs to be driven to overcome challenges in the adoption of the technology.

IV. Strategies for technology adoption:

a) Investment in experimentation: P9 noted the need for investment in experimentation, indicating that the dedication is evident in adopting and exploring new technologies.
b) Embracing new technology: P8 emphasised the need to embrace blockchain technology. Having a positive perspective toward technology adoption.

V. Strategies for market intelligence:

a) Education and broad participation: P6 mentioned the importance of educating internal staff and the community to improve market intelligence. The Bank intends to foster wider inclusivity within the market.

In summary, the thematic analysis revealed a range of strategies and approaches the South African Commercial Bank plans to employ in order to overcome the challenges associated with adopting BCT for payment services. These strategies include improving regulatory reporting infrastructure, collaborating closely with regulators, engaging with regulators to build controls, conducting rigorous evaluations, identifying partners, participating in blockchain networks, expanding the ecosystem, driving cultural change, embracing new technology, investing in experimentation, and promoting education and market intelligence. These strategies reflect the Bank's proactive approach to addressing challenges and successfully implementing blockchain technology in payment services.

Finding 17: It is important for the Bank to establish control systems and levels of comfort with regulators to ensure visibility and making certain that respect for the laws of the country as well as other countries are not compromised in terms of compliance, governance and regulation.

Finding18: Collaboration and building strong partnerships with other banks internationally are key to overcoming some of the challenges faced with in payment services.

Finding 19: Change in organisational culture, specifically change in thinking, will help in solving some of the challenges.

Finding 20: Embracing BCT in payment services is still challenging, and investing money in experimentation is slow.

Finding 21: It is important for the Bank to have market intelligence about what is happening in the existing market, for competition and growth.

Interview Question 2B (IQ2B): South African legislation and banking governance is very strict in terms of data privacy and security. How can blockchain technology strengthen data privacy in financial transactions?

In line with Research Question 1 (RQ1), Interview Question 2B explores how blockchain technology can strengthen data privacy in financial transactions within the strict legislative and banking governance environment of South Africa. The following insights were identified from the participants' responses:

I. **Strengthening data privacy through cryptography**:
   a) Data encryption: Participants (P1, P5, P6, P8, P11, P14) emphasised the role of cryptography in blockchain technology to strengthen data privacy. Data stored on the blockchain is encrypted, restricting easy access to sensitive information by unauthorised users.

II. **Self-sovereign identity (SSI):**
   a) SSI for identity control: Participants (P11, P14) mentioned the concept of self-sovereign identity (SSI) as a means to strengthen data privacy. With SSI individuals manage and control their identity data. and blockchain technology safeguards this sovereignty against unauthorised access.

III. **Utilisation of private networks**:
   a) Private blockchain networks: Participants (P1, P3, P12) highlighted the use of private blockchain networks that restrict access to selected participants. These private networks enhance data privacy by limiting who can view and interact with the information.

IV. **Doubts and contrary opinions:**
   a) Privacy vs. visibility debate: P8 and P11 argued that blockchain technology, by design, may not necessarily cater to data privacy. They suggested that blockchain focuses more on data control than data privacy. Additionally, P13 mentioned that transactional data visibility is essential for monitoring and should not necessarily be private, highlighting a perspective that favours transparency over privacy.
   b) Doubt regarding data privacy improvement: P2 was doubtful as to whether blockchain technology can improve data privacy, suggesting some reservations regarding its effectiveness.

In summary, the thematic analysis revealed that blockchain technology holds the potential to strengthen data privacy in financial transactions within the South African legislative and banking governance environment. The key techniques to enhance data privacy include the implementation of self-sovereign identity (SSI) systems, utilisation of private blockchain networks and data encryption through cryptography. However, there are contrasting views, with some participants expressing sceptics about the technology's ability to improve data privacy and others emphasising the balance between visibility and privacy in transactional data.

Finding 22: BCT can strengthen data privacy in financial transactions by using the process of cryptography to enable encryption.

Finding 23: BCT can strengthen data privacy in financial transactions by using an identity management system called Self-Sovereign Identity (SSI).

Finding 24: BCT can strengthen data privacy in financial transactions by using private networks.

Finding 25: On the other hand, P2 was not sure that BCT could strengthen data privacy in financial transactions.

Finding 26: Participants P8 and P11 argued that blockchain technology does not provide data privacy.

Finding 27: P13 alluded to the fact that data should not be private as it hinders the process of monitoring transactions.

Interview Question 2C (IQ2C): With the challenge of interoperability, how does the Bank apply protocol that enables blockchain economies to operate outside silos and transfer files between each other?

In line with Research Question 2 (RQ2), Interview Question 2C explores how the South African Commercial Bank applies protocols to address the challenge of interoperability and enable blockchain economies to operate outside of silos. The following insights were identified from the participants' responses:

I. API layer for integration:

a) Unique API layer: P1 described the Bank's approach to addressing interoperability challenges by building a unique API layer around their blockchain. This layer enables integration with various systems and channels, allowing the Bank to connect different entities and branches across Africa.

II. **Consensus mechanism and trust:**

b) Single trusted area of transaction: P13 discussed the concept of a single trusted area of transaction, where multiple blockchains and ecosystems can be connected to work together seamlessly. This approach eliminates the need for protocols and tedious reconciliations, as consensus mechanisms drive trust in the accepted truth at any given time.

III. **Blockchain protocols for interoperability**:

a) Blockchain protocols: P15 mentioned the use of blockchain protocols that promote interoperability as a solution to address the challenge. These protocols are designed to facilitate communication and data transfer between different blockchain networks.

VI. **Challenges and lack of strategic decisions:**

a) Fragmented business areas: P3 highlighted the current state where different business areas within the Bank are pursuing their own initiatives, leading to a fragmented approach. There is no overarching architecture to bring everything together, and the Bank has not yet made a strategic decision in this regard.

In summary, the thematic analysis revealed that the South African Commercial Bank employs a combination of approaches to address interoperability challenges and enable blockchain economies to operate outside silos:

- The concept of a single trusted area of transaction, driven by consensus mechanisms, eliminates the need for traditional protocols.
- The use of blockchain protocols that promote interoperability is considered a potential solution.
- The Bank has developed a unique API layer to facilitate integration across various systems and channels, connecting different bank entities and branches.
- However, there are challenges, as different business areas within the Bank currently operate independently, and there is a lack of a comprehensive architecture to bring everything together. Strategic decisions regarding interoperability have not yet been finalised.

Finding 28: Eleven (11) participants felt that the Bank has a solution in place in terms of interoperability by using APIs and applying consensus mechanisms for the different silos within the Bank to interact.

Finding 29: P3 felt that there is framework in place to unite the different silos.

Interview Question 2D (IQ2D): What type of risks could the Bank encounter by transitioning to BCT?

In line with Research Question 1 (RQ1), Interview Question 2D explores the types of risks that the South African Commercial Bank could encounter by transitioning to blockchain technology (BCT). The researcher identified the following insights from the participants' responses:

I. Compliance, governance, and regulation risks:

a) Regulatory challenges: Several participants (P6, P8, P9, P10, P14) highlighted regulatory and compliance risks as significant concerns when transitioning to BCT. This includes challenges related to regulatory frameworks, compliance with personal information protection, and the permanence of information on the blockchain, which may conflict with data retention laws.

II. Counter-argument:

a) Counter-argument in favour of adoption: P13 presented a counter-argument by stating that reluctance to adopt may be a bigger risk than the technology itself. The participant cautioned that avoiding BCT adoption could marginalise the Bank's future as the financial world is steadily moving toward distributed ledgers.

III. General technological transition risks:

a) Technology adoption risk: Participants (P4, P9, P11) expressed concerns about adopting emerging technologies, highlighting the inherent risks connected to unproven solutions, the challenges and the high costs involved in aligning with legacy systems.

In summary, the thematic analysis revealed that transitioning to BCT involves several types of risks for the South African Commercial Bank:

- Compliance, governance, and regulation risks related to navigating regulatory frameworks, ensuring data protection, and managing data permanence on the blockchain.
- General technological transition risks, including uncertainty, untested technology, and the challenges of integration.
- However, there is a counter-argument suggesting that the biggest risk lies in not adopting BCT and potentially becoming irrelevant in the evolving global financial landscape.

Finding 30: Any new technological adoption entails a certain measure of risk.

Finding 31: P13 argued that it is a mistake and a big risk to not transition to BCT.

Finding 32: Risks arise from pioneering ahead of national and international regulatory frameworks.

Finding 33: Current compliance, governance and regulation is the opposite of what BCT offers in payment services in respect of data privacy and retention period of information.

Interview Question 2E (IQ2E): How does BCT affect the integration of legacy architecture and new business models?

In line with Research Question 1 (RQ1), Interview Question 2E explores how BCT affects the integration of legacy architecture and new business models. The following insights were identified from the participants' responses:

I. **No impact or complementary integration:**
   a) Participants (P1, P2, P8, P9) expressed the view that BCT does not significantly affect the integration of legacy architecture and new business models. They suggested that BCT can complement existing systems and processes through methods like implementing an API layer, successful interoperability, automation, and the use of APIs. In their opinion, BCT fits seamlessly with existing architectures.

II. **No need for integration**:
   a) Participants (P3, P5, P7) believed that there may not be a need for integration as BCT could replace or rebuild legacy systems to work on the new technology. They saw BCT as potentially replacing legacy systems entirely, unlocking new business potential, and eliminating certain processes and systems.

III. **Caution against integration (not suitable for integration)**:
   a) P13 expressed a different perspective, suggesting that it might not be a good idea to integrate blockchain into legacy architecture. The participant believed that blockchain technology is not suited for integration into legacy systems, as it may not align with the goals and objectives of blockchain.

In summary, the thematic analysis revealed diverse perspectives on how BCT affects the integration of legacy architecture and new business models:

- Some participants believed that BCT can seamlessly complement existing systems and processes, requiring integration methods like APIs and interoperability.
- Others argued that BCT might not necessitate integration, as it can potentially replace or rebuild legacy systems to support new business models.
- One participant expressed caution against integration, suggesting that blockchain may not be suitable for integration into legacy architecture due to misalignment with its intended goals.

The impact of BCT on integration appears to depend on the specific use cases and strategies adopted by the South African Commercial Bank and its approach to leveraging blockchain technology.

Finding 34: With the use of APIs, there would be no impact on the integration of legacy architecture and new business models.

Finding 35: With the use of BCT, there would not be a need for integration as it could cancel entire processes and expunge existing legacy systems.

Finding 36: P13 felt that integrating BCT into legacy architecture was not advisable as it does not align with the purpose of what BCT is meant to fulfil.

Interview Question 2F (IQ2F): How does BCT assimilate into the current technology stack?

In line with Research Question 1 (RQ1), Interview Question 2F explores how BCT assimilates into the current technology stack. The following insights were derived from thematically analysing the participants' responses:

I. Integration with existing technology:

a) Integration with existing tech: Participants (P7, P14) highlighted the integration of BCT with existing technology as a common approach. In early-stage projects and proof of concepts, it is more likely to integrate with existing systems rather than creating entirely new solutions. The integration is facilitated through APIs (Application Programming Interfaces), making it a seamless process. Blockchain technology is considered API-driven and can be assimilated similar to any other system installation.

II. **Building independent infrastructure:**

a) Independent infrastructure: Participant P6 offered an alternative approach by suggesting that building the infrastructure for blockchain from the ground up independently, without tying it to legacy systems, could be an effective strategy. This approach aims to avoid the constraints of old technologies and banking practices.

III. **Addressing legacy system limitations:**

a) Addressing legacy system limitations: Participant P15 acknowledged that many legacy systems may not be API-enabled, which can present challenges for integration with blockchain technology. To address this limitation, new technologies may need to be introduced to facilitate the integration process.

In summary, the thematic analysis revealed that the assimilation of BCT into the current technology stack can be approached in several ways:

- Some participants suggested building blockchain infrastructure independently without tying it to legacy systems as an alternative approach to avoid the constraints of legacy technology.
- Integrating BCT with existing technology is a common practice, particularly in proof of concepts and early-stage projects. APIs play a crucial role in facilitating this integration.
- The need to address limitations in legacy systems, such as the lack of API enablement, may require the introduction of new technologies to facilitate the integration of blockchain.

Finding 37: There appears to be a difference of opinion as some participants felt assimilation into the current technology stack can be achieved through pilot projects and the use of APIs, whilst others felt that legacy systems should not be integrated but that brand new architecture should be introduced to avoid going back to the old way of working.

Interview Question 2G (IQ2G): How does BCT onboard historical transactional (analogue) data and merge it with current data?

In line with Research Question 1 (RQ1), Interview Question 2G explores how BCT onboards historical transactional (analogue) data and merges it with current data. The following insights were derived from the participants' responses:

I. Recreating transactions anew:

a) Participant P6 suggested that the approach to handling historical transactional data is to recreate these transactions anew within the new blockchain infrastructure. This implies that historical data may not be directly migrated but rather re-entered or re-recorded in the new system.

II. Migration of historical data:

a) Compliance and legacy data retention: Participant P13 emphasised the Bank's requirement to hold information for a specific duration (five years) to comply with regulations. The participant suggested that when transitioning to blockchain, the existing databases and information in the legacy construct may be maintained for compliance purposes during this period.

b) Migration where feasible: Participant P7 mentioned that historical data will likely be migrated to the blockchain where feasible. In specific cases where it is not deemed necessary, there may be a 'closing out' period, suggesting that certain data may be archived or phased out.

III. Selectively storing relevant data:

a) Selective onboarding of data: Participant P15 argued that blockchain does not need to onboard a significant amount of historical data from current databases onto the blockchain-based database. The participant believed that it would be costly and suggested that blockchain should store only relevant and necessary data, avoiding unnecessary migration.

IV. Starting with new data:

a) Participant P16 emphasised that when implementing a blockchain solution, there is typically no direct migration of existing data onto the blockchain. Instead, the blockchain starts with new data generated from that point onward.

In summary, the thematic analysis revealed that the approach to onboarding historical transactional data and merging it with current data in the context of BCT varies:

- Some participants suggested recreating historical transactions anew within the new blockchain infrastructure.
- There is consideration for the cost-effectiveness and relevance of migrating historical data to the blockchain.
- Others mentioned the feasibility of migrating historical data to the blockchain, complying with data retention regulations, or archiving data during a transition period.
- The commonality is that blockchain typically starts with new data, and historical data may or may not be directly migrated depending on specific needs and feasibility.

Finding 38: There was a general feeling among the participants that historical data would be transferred to the new technology.

Finding 39: P12 stated that the Bank has to comply with legislation to hold information for five years and for this reason, the existing databases will need to be held for five years.

Finding 40: Two participants disagreed that historical data should be onboarded on a blockchain; instead, it should be stored off-chain.

Interview Question 2H (IQ2H): Blockchain has an environmental cost. In terms of taking the environment into consideration, how does the Bank overcome the issue of consuming high amounts energy?

In line with Research Question 1 (RQ1), Interview Question 2H explores how the Bank overcomes the environmental cost of consuming high amounts of energy associated with BCT. The following insights were derived from the participants' responses:

I. Awareness of environmental impact:

a) Recognition of environmental impact: Participant P7 acknowledged that blockchain technology, especially in the context of cryptocurrency, has a significant impact on the environment. This highlights awareness of the environmental cost associated with blockchain.

II. Bank's approach to environmental concerns:

a) Greening legacy systems: Participant P11 suggested that adopting blockchain technology, while decommissioning legacy systems, can lead to a greener approach. By reducing the need for more servers and infrastructure, blockchain can potentially contribute to a more environmentally friendly technology stack.

b) Promotion of energy-efficient versions: Participant P15 discussed the Bank's use of newer versions of Hyperledger and other blockchain platforms that actively promote throughput at lower cost. This is expected to result in significantly reduced environmental damage compared to mining activities.

c) Carbon neutral ecosystem: Participant P13 mentioned that the Bank is in the process of establishing a node and intends to start mining. However, the participant highlighted that the Bank is part of a carbon-neutral ecosystem that uses different algorithms and technologies compared to Bitcoin's energy-intensive consensus mechanism. This indicates an effort to minimise the environmental impact of blockchain activities.

d) Environmental projects and carbon footprint: Participant P10 mentioned that the Bank is actively involved in environmental projects but not engaged in mining activities. Therefore, the Bank's operations do not contribute to consuming high amounts of energy. This suggests a proactive approach to address environmental concerns.

In summary, the thematic analysis revealed that the Bank adopts various strategies and approaches to overcome the environmental cost associated with blockchain technology:

- The Bank is actively involved in environmental projects and avoids energy-intensive activities like mining.
- Blockchain adoption is seen as a way to reduce the carbon footprint by replacing legacy systems and potentially contributing to a greener technology stack.
- There is recognition of the environmental impact of blockchain, particularly in cryptocurrency.
- Efforts are made to use energy-efficient versions of blockchain platforms to reduce the environmental impact.
- The Bank is exploring carbon-neutral ecosystems and technologies to minimise environmental damage.

Finding 41: The general feeling of the participants was that the Bank is very conscious of their carbon footprint, hence their use of BCT would not have a negative effect on the environment, especially because there is no need for mining in the banking industry.

Finding 42: P11 alluded to the fact that the Bank would contribute to a healthier environment by discontinuing legacy architecture and replacing it with BCT.

Based on the responses provided for Interview Question 2I1 and Interview Question 2I2 regarding the Bank's technical expertise and the potential impact on IT staff, the thematic findings are as follows:

Interview Question 2I1 (IQ2I1): Sufficiency of technical expertise

All thirteen participants who answered this question indicated that the Bank lacks sufficient technical expertise to manage BCT, which suggests a consensus among the respondents that the Bank faces a shortage of in-house experts in the field of blockchain. This indicates that there are not enough experts within the Bank to manage BCT.

Finding 43: There are not enough experts within the Bank to manage BCT.

Interview Question 2I2 (IQ2I2): Impact on IT staff complement

The responses to this question were mixed and conflicting:

- Three (3) participants believed that the use of BCT would increase the IT staff complement.
- Three (3) participants believed that BCT adoption would decrease the IT staff complement.
- Two (2) participants believed that there would be an initial increase in IT staff followed by a decrease.
- Two (2) participants believed that the IT staff complement would remain constant.
- Six (6) participants did not provide a response to this question.

The conflicting responses suggest that there is no clear consensus on how the adoption of BCT technology would affect the IT staff complement within the Bank. Different participants have varying opinions, including expectations of both increases and decreases in IT staff numbers or no significant change.

Finding 44: The information received is conflicting in that some participants felt that the adoption of BCT would decrease staff, whilst others felt that it would create a need for more staff. Contrarily, some felt it would not have any effect on the staff compliment. Furthermore, some felt it would initially cause an increase and thereafter a decrease.

Interview Question 2I3 (IQ2I3): Would BCT require other banking personnel like myself to undergo a steep learning curve?

Based on Interview Question 2I3 and the insights derived from the interviews, participants had mixed perspectives on whether BCT implementation would necessitate a steep learning curve or upskilling for the broader banking personnel.

Participant responses

Of the sixteen interviewees:

- Six (6) participants believed that upskilling in their respective divisions would be necessary for the effective adoption of BCT, suggesting that specialised knowledge might be required to handle the intricacies of blockchain.
- Six (6) participants felt that additional upskilling for the broader staff would not be necessary, indicating confidence that existing skills would be sufficient or that BCT could be integrated without a major adjustment in staff knowledge.
- Four (4) participants chose not to provide a response.

The above differences of opinion voiced by the participants highlights the potential need for further evaluation within the Bank to determine specific upskilling requirements for BCT. It also suggests that if BCT is adopted, tailored training programmes may be necessary for certain divisions, while other staff members might continue with their roles unaffected.

Finding 45: The feedback on upskilling requirements was divided, reflecting a clash in perspectives. Half of the participants viewed upskilling as essential, implying that BCT might introduce complexities that require specialised knowledge. The other half felt that additional training was unnecessary, possibly due to the perceived simplicity or user-friendliness of the technology or the Bank's ability to incorporate BCT without extensive staff re-education.

Interview Question 2J (IQ2J): Change is a crucial component of growth and evolution. However, change inevitably also poses challenges. What obstacles are management being faced with in respect of changing to BCT?

In line with Research Question 1 (RQ1), Interview Question 2J explores the obstacles that management faces when transitioning to BCT. The following insights were identified from the participants' responses:

I. Resource allocation and capital constraints:

a) Capital resources for modernisation: Participant P2 mentioned funding to replace outdated technologies is challenging as there may not necessarily be a budget for this. This suggests that financial limitations may obstruct the adoption of BCT.

II. Skills and expertise shortage:

a) Lack of qualified individuals: Participant P4 highlighted that finding professionals with the right skill set to aid with the adoption of BCT is difficult, particularly in the payments environment. This indicates a scarcity of qualified specialists in the field.

III. Integration and legacy systems:

a) Legacy systems integration: Participant P5 noted the challenge of integrating BCT with legacy systems and managing these existing systems. This integration hurdle can slow down the transition to blockchain technology.

b) Silos and barriers: Participant P5 also mentioned the presence of organisational silos. The discord between departments can cause a setback in the adoption of BCT.

IV. Regulatory uncertainty:

a) Regulatory challenges: Participant P5 highlighted the ongoing doubt specifically around BCT regulations. Regulatory uncertainty is a huge obstacle for management to be able to navigate the legal framework of BCT.

V. Strategic management:

a) Need for strategic leadership: Participant P10 suggested that management needs to adopt a strategic approach to overcome the challenges associated with BCT adoption. This implies that that firstly, a strong leadership team is required and secondly, careful and thorough planning are crucial to ensure a smooth transition.

VI. Resistance and misconceptions:

a) Resistance to change: Participant P13 mentioned some individuals prefer to hold on to familiar technologies instead of embracing modern solutions.

b) Perception vs. reality: Participant P14 pointed out the challenge of battling misconceptions, particularly the association of blockchain with cryptocurrencies. Addressing these misconceptions and trying to reshape the understanding of the technology can be essential for its successful adoption.

In summary, the thematic analysis revealed that management faces several obstacles when transitioning to BCT:

- The necessity for strategic leadership and planning.
- Uncertainty in the regulatory environment.
- Capital constraints and the need for resources to replace outdated technologies.
- Shortage of qualified individuals with expertise in BCT.
- Challenges related to integrating BCT with legacy systems and breaking down internal silos.
- Resistance to change and misconceptions about BCT.
- These challenges highlight the multifaceted nature of the obstacles that management encounters in the process of adopting BCT.

Finding 46: There is a lack of financial resources to sandbox legacy technology.

Finding 47: There is a shortage of BCT skills set particularly in the payments environment.

Finding 48: Teams within the Bank are not open to collaboration to integrate the legacy systems.

Finding 49: Regulation is an ongoing challenge as there is no clear way of managing BCT going forward.

Finding 50: Management does not have strategy in place to embrace BCT.

Finding 51: Employees are resistant to change due to lack of clarity and reasons for the change.

Finding 52: The educational piece is lacking hence employees do not have a clear understanding of BCT.

With regard to benefits of BCT on payment services in the banking sector:

Interview Question 3A (IQ3A): Payment services are an income generator to the Bank. In which way can BCT add more value to enhance income generation?

In line with Research Question 2 (RQ2), Interview Question 3A explores how BCT can add more value to enhance income generation in payment services within the banking sector. The following insights were derived from the participants' responses:

I. Diversification of services and revenue streams:

a) Introduction of new services: Participant P6 suggested that BCT can potentially enable the creation of new services and revenue lines, including new forms of settlement, collateral transformation, digital asset deposit and loans, tokenised asset management and digital asset custody. This indicates that BCT can boost revenue by diversifying services.

II. Cost reduction and efficiency:

a) Lower transaction costs: Participant P7 mentioned that BCT can contribute to increase revenue by providing discounted transactional fees. Reduced fees can lead to increased profits for the Bank.

b) Improved customer relationships: Participant P8 highlighted that BCT can increase client relationship, due to clients having the option of utilising more services. Enhanced client relationships can translate into higher income for the Bank, potentially through increased usage of services.

c) Infrastructure savings: Participant P14 emphasised the potential for significant infrastructure savings when adopting BCT. The elimination of third-party intermediaries, managing reconciliation processes and decentralising payments can reduce costs, leading to income generation.

d) Streamlined processes and reduced costs: Participant P16 pointed out that BCT can eliminate the need for multiple systems and processes involved in reconciliation and auditing. As a result, costs can be significantly reduced. Streamlining processes and reducing operational costs can enhance income generation.

In summary, the thematic analysis highlights the ways in which BCT can add more value to enhance income generation in payment services within the banking sector:

- Improved customer relationships and increased service usage.
- Streamlined processes and reduced operational costs.
- Diversification of services and the introduction of new revenue streams.
- Cost reduction through cheaper transaction costs and infrastructure savings.

These factors collectively contribute to the potential for BCT to enhance income generation within the banking sector's payment services.

Finding 53: BCT can generate revenue for the Bank through potentially new products or services e.g., digital asset custody, digital asset loans and deposits.

Finding 54: With the use of BCT, services could be more effective, which could lead to client expansion, which, in turn, could stimulate revenue growth.

Finding 55: BCT optimises the management of infrastructure, which reduces costs significantly as payment services are maintained and controlled by a centralised single entity.

Finding 56: BCT effectively automates portions of audit processes, which reduces the cost of monitoring since the accuracy of all transactions in the information systems will be time- stamped with real-time audits trails.

Interview Question 3B1 (IQ3B1): How does BCT reduce cost for the Bank in effecting payments in respect of P2P?

In line with Research Question 2 (RQ2), Interview Question 3B1 explores how BCT reduces costs for banks in effecting peer-to-peer (P2P) payments. Through thematic analysis, the following insights were identified from the participants' responses:

I. Cost reduction and efficiency:

a) Inherent cost savings of BCT: Participants P4 and P12, among others,

emphasised that BCT offers inherent cost savings compared to legacy payment systems. They mentioned that BCT is cheaper, faster, and requires less human oversight. P12 specifically mentioned that the Bank can reduce costs to close to zero by leveraging blockchain technology. This underscores the cost-efficiency aspect of BCT.

b) Reduction in processing time: Participant P13 pointed out that BCT can lead to a significant reduction in the processing time for payments. Faster processing can contribute to cost savings by optimising operational efficiency.

c) Focus on peer-to-peer payments: Participant P15 mentioned that certain blockchain-based protocols like Ripple focus on peer-to-peer payments and institutional payments. These protocols aim to reduce banking-related costs associated with payment processing. This highlights the specific impact of BCT on P2P payments.

In summary, the thematic analysis revealed how BCT reduces costs for banks in effecting peer-to-peer (P2P) payments:

- BCT offers inherent cost savings by being cheaper and more efficient than legacy payment systems.
- BCT can significantly reduce processing times for payments.
- Blockchain-based protocols such as Ripple specifically target cost reduction in peer-to-peer and institutional payments.

These factors collectively contribute to the cost-reduction benefits of BCT in the context of P2P payments for banks.

Finding 57: BCT reduces cost in P2P payments as less human oversight is required.

Finding 58: P2P payments require costly network and IT infrastructure support, which, with the use of BCT, can be reduced significantly.

Finding 59: Processing time for P2P payments will be reduced, which ultimately reduces banking costs.

Interview Question 3B2 (IQ3B2): How does BCT reduce cost for the Bank in effecting payments in respect of international payments and cross-currency payments?

In line with Research Question 2 (RQ2), Interview Question 3B2 explores how BCT reduces costs for banks in effecting international payments and cross-currency payments. the

following insights were identified from the participants' responses:

I. **Cost reduction in international payments and cross-currency payments**:
    a) Automation through smart contracts: Participant P1 highlighted the role of smart contracts in reducing costs. Smart contracts can automate various aspects of international payments, such as operations and validation. This automation streamlines processes, lowers operational expenses, and minimises the need for manual intervention.
    b) Elimination of third-party correspondent banking and SWIFT: Participant P2 emphasised that BCT reduces the need for third-party correspondent banking systems and SWIFT. Traditional international payment systems often involve multiple intermediaries and fees. By leveraging blockchain technology, banks can conduct cross-border transactions directly and eliminate the costs associated with intermediaries.
    c) Cloud-based solutions and distributed resources: Participant P7 mentioned the adoption of cloud-based solutions that run on a blockchain network. These solutions distribute hardware and software resources across many connected devices. This structure reduces the costs of maintaining a centralised infrastructure and allows for cheaper pricing models for global banking.

In summary, the thematic analysis revealed how BCT reduces costs for banks in effecting international payments and cross-currency payments:

- Cloud-based solutions hosted on a blockchain network distribute resources efficiently, thus leading to cost savings.
- BCT eliminates the need for third-party correspondent banking systems and SWIFT, thereby reducing intermediary fees.
- Operational costs are reduced as processes are automated with smart contracts.

These factors collectively contribute to the cost-reduction benefits of BCT in the context of international and cross-currency payments for banks.

Finding 60: BCT reduces the need for third party correspondent banking systems and SWIFT in cross-border payments by using smart contracts that reduce costs and subsequently enable exploration of different pricing models for clients.

Interview Question 3B3 (IQ3B3): How can BCT reduce cost for the Bank in effecting payments in respect of keeping records of transactions?

In line with Research Question 2 (RQ2), Interview Question 3B3 explores how BCT can reduce costs for banks in terms of keeping records of transactions. The following insights were derived from the participants' responses:

I. **Efficient transaction record-keeping with blockchain:**
    a) Automatic recording through Hyperledger: Participant P5 mentioned Hyperledger technology which is built for commercial use and automates the recording of transactions. With the addition of new blocks to the chain transactions are securely recorded, eradicating manual input of data and maintaining system updates.
    b) Real-time and cloud-based records: Participant P2 highlighted the use of real-time, cloud-based records facilitated by blockchain technology. Blockchain enables transactions to be recorded instantly and securely on a distributed ledger accessible through cloud-based solutions. This real-time recording reduces the need for extensive manual record-keeping processes and associated costs.

In summary, the thematic analysis revealed how BCT can reduce costs for banks in terms of keeping records of transactions:

- Automatic recording of transactions through Hyperledger technologies reduces the costs associated with manual input of data and maintenance.
- BCT enables real-time and cloud-based record-keeping, eradicating the need for manual and time-consuming processes.

These factors contribute to more efficient and cost-effective transaction record-keeping for banks using blockchain technology.

Finding 61: With BCT, the initiation, processing, authorisation, recording and reporting of transactions improves the record-keeping process.

Interview Question 3C1 (IQC1): Would BCT give the organisation a competitive advantage in the financial sector?

In line with Research Question 2 (RQ2**),** Interview Question C1 explores whether BCT would give the organisation a competitive advantage in the financial sector. The following insights were derived from the participants' responses:

I. **Potential for competitive advantage with BCT:**
    a) Dependent on blockchain journey: Participant P15 acknowledged that BCT's

ability to confer a competitive advantage depends on implantation progression within the organisation. This suggests that the competitive advantage may be influenced by factors such as the organisation's level of blockchain adoption, expertise, and the specific use cases implemented.

b) Conditional competitive advantage: Participant P1 expressed a positive outlook, indicating that BCT has the potential to provide a competitive advantage to the organisation. However, this advantage is contingent on implementing blockchain technology effectively and efficiently. In other words, it depends on how well the organisation leverages blockchain to its advantage.

In summary, the thematic analysis revealed the following insights on whether BCT would give the organisation a competitive advantage in the financial sector:

- The competitive advantage is measured by the organisation's growth in its blockchain journey.
- Whilst BCT could probably provide a competitive advantage, successful utilisation depends on effective implementation.

These insights highlight the potential impact of BCT adoption in shaping the Bank's competitive status in the market.

Finding 62: The Bank believes that adopting BCT will give the organisation a competitive advantage.

Interview Question 3C2 (IQ3C2): If yes, in which way?

In line with Research Question 2 (RQ2), Interview Question 3C2 explores in what ways BCT can provide a competitive advantage in the financial sector. The following insights were identified from the participants' responses:

I. Ways in which BCT can provide a competitive advantage:

a) Enhanced user experience: Participant P1 also mentioned the importance of a good user interface for clients. BCT can provide an advantage by offering a self-service tracking system and an excellent user experience, making it more appealing to customers.

b) Transparency and immutability: Participant P7 highlights that BCT's transparency and immutable nature creates opportunities to enhance customer experiences. The transparency ensures trust, while immutability ensures the security and integrity of transactions, thereby improving the overall customer experience.

c) Low transaction costs: Participant P1 suggested that the use of BCT provides low-cost fees or even ‘no fees, which presents a competitive advantage. This can provide economical payment options, attracting clients and increasing market share.
d) Inclusivity and partnerships: Participant P13 further emphasised that BCT is not only about winning or losing, but also about creating partnerships and ecosystems. This inclusive approach can foster innovation and new business model and ultimately provide a competitive advantage.
e) Value in collaboration: Participants P9 and P13 emphasised that the value of BCT lies in its ability to facilitate collaboration and sharing of data among multiple parties. This collaborative approach can lead to new opportunities, efficiencies and enhanced services that provide a competitive edge.

In summary, the thematic analysis revealed various ways in which BCT can provide a competitive advantage in the financial sector:

- User experience can be enhanced by providing a good user interface for clients.
- Transparency and immutability enhance trust and security, improving the overall customer experience.
- Collaboration and data sharing among multiple parties create new opportunities and efficiencies.
- An inclusive approach and partnerships can foster innovation and new business models.
- Low transaction costs and user-friendly interfaces can attract clients and market share.

These responses highlight the multifaceted nature of how BCT can be leveraged to stay ahead in the market, ranging from cost savings to improved customer experiences and collaborative innovation.

Finding 63: Early adoption of the technology can give the Bank a competitive advantage by optimising on transaction costs, thereby strengthening its place in the market.

Finding 64: Competitive advantage to the Bank does not necessarily mean being better than others, but rather fostering strategic alliances, thereby creating collaborative advantage, which can be utilised for the fuller value-creating potential of the broader ecosystems wherein they operate.

Interview Question 3D (IQ3D): How would BCT overall be a value-add to both the organisation and your client-base?

Interview Question 3D explores how BCT can be a value-add for both the organisation and its client-base. The following insights were identified from the participants' responses:

I. **Ways in which BCT adds Value to the organisation and clients:**
   a) Collaborative environment: Participant P13 emphasised that the development of a collaborative blockchain and distributed ledger environment can cultivate new prospects, which can lead to shared benefits among stakeholders, including the organisation and its clientele.
   b) Exposure to new businesses: Participant P7 highlighted that through BCT there is a growth opportunity for import and export. This exposure can build strong client relationships between buyers and sellers, therewith benefiting the organisation and its clientele.
   c) Efficiency and cross-selling: Participant P1 suggested that BCT can enable the organisation to diversify its product offering and services. Furthermore, improved efficiency can result in transactions being processed faster which is a value-add to both the organisation and its clientele.
   d) Closed-loop ecosystems and cost savings: Participant P15 mentioned that BCT enables banks to create closed-loop ecosystems. In these ecosystems, allows banks to define the participants and create payment networks, resulting in reduced costs. These cost savings can be shifted to clients, making banking inexpensive and boosting the competitive edge of service offering.

In summary, the thematic analysis revealed various ways in which BCT can add value to the organisation and its clientele:

- Exposure to new businesses and opportunities.
- Enhanced efficiency in services and transactions.
- Relationship building in a mutually beneficial ecosystem.
- Formation of commercially viable, closed-loop ecosystems that provide mutual benefits to the business and its clientele.

These responses illustrate the potential of BCT to create value by improving operational efficiency, expanding business horizons, fostering collaboration, and offering cost-effective solutions to the organisation and its clients.

Finding 65: BCT can maintain digital integration between customers and partners.

Finding 66: BCT can unlock the gate to establish an autonomous open and scalable payment network system, providing operational efficiency and performance excellence.

With regard to the implication of BCT on payment services at a South African Commercial Bank:

Interview Question 4A (IQ4A): What are the difficulties experienced when executing payment services?

Interview Question 4A investigates the difficulties experienced when executing payment services. The following insights were identified from the participants' responses:

I. Challenges in executing payment services:

a) Volume and infrastructure strain: Participants P10 and P15 mentioned challenges related to high transaction volumes and infrastructure strain. High-volume transactions, especially in the case of small transactions, can strain IT systems and affect processing efficiency. Implementing blockchain technology at scale in a complex network is also seen as challenging.

b) Partnership and network participation: Participant P14 emphasised the importance of partnerships and getting parties to agree to join a payment network. Building a network and bringing participants on board can be challenging.

c) Regulatory and compliance challenges: Participants P1, P9, P12 and P13 highlighted the regulatory and compliance challenges associated with executing payment services. This includes reporting to regulators, dealing with multiple regulators for cross-border payments, and the absence of clear regulations for digital assets and payment mechanisms. Regulatory compliance is a complex and evolving aspect of payment services.

d) Legacy systems and integration: Participants P2, P3, P5 and P8 discussed the challenges related to legacy systems and integration with existing systems. Legacy systems can be inefficient, and integrating blockchain technology into established systems can be complex. This can result in delays and batch processing.

e) Data accuracy and due diligence: Participants P1, P10, P12 and P14 pointed out issues related to data accuracy, beneficiary details, and due diligence in the payment process. Ensuring that payment details are accurate and conducting proper due diligence are crucial to preventing errors and fraud.

f) Authorisation and authority levels: Participants P10 and P12 mentioned challenges related to authorisation processes and defining authority levels for payment transactions. Ensuring that the right individuals have the appropriate authorisation is essential for security and compliance.
g) Lack of understanding and education: Participants P8 and P9 emphasised the need for education and understanding of blockchain technology. Some individuals within the organisation may not fully grasp the benefits of blockchain, leading to resistance or reluctance to adopt new technology.
h) Scaling and network challenges: Participants P6, P10 and P16 discuss challenges related to scaling, throughput management, and network reliability. Ensuring that the blockchain network can handle increased transaction volumes and maintaining network uptime are essential considerations.

In summary, the thematic analysis revealed various challenges faced when executing payment services in the context of blockchain technology implementation:

- Volume and infrastructure strain.
- Regulatory and compliance complexities.
- Scaling and network challenges.
- Building partnerships and network participation.
- Legacy systems and integration difficulties.
- Lack of understanding and education about blockchain.
- Data accuracy and due diligence requirements.
- Authorisation and authority level definition.

Overcoming these obstacles is essential for the successful adoption of blockchain technology in payment services at a South African Commercial Bank.

Finding 67: The difficulty in executing payment services lies in the fact that regulators globally are finding it difficult to structure a clear framework to govern BCT, which is designed to be self-regulating and self-maintaining. This is prohibiting the Bank from gravitating to an innovative approach to launch successful initiatives as they are currently compelled to take on a risk-averse approach.

Finding 68: Legacy systems for payment services were developed many years ago, which currently lacks the ability to keep up with modern technologies. Modern payment solutions help to scale a business but as a result of the Bank being at the core of their overall banking architecture, making changes to their systems would affect daily operations. However, the delay in making changes, ultimately hinders business growth.

Finding 69: Inertia (persistence to use incumbent systems whilst there are better alternatives), appears to be applicable not only to individuals, but also to organisations.

Finding 70: The formation of collaborative innovation partnerships to build an effect payment network is challenging.

Finding 71: Traditional payment systems pose challenges such as lack of speed, downtime, scaling issues, throughput management and wrong beneficiary details, especially with cross- border payments.

Finding 72: Internal processes to effect payment services are long-winded.

Interview Question 4B (IQ4B): What are the risks for the Bank when performing payment services?

Interview Question 4B explores the risks for the Bank when performing payment services. The following insights were derived from the participants' responses:

I. Risks in traditional payment services:

a) Lost payments: Participant P6 mentioned that there is a high risk of payments not being allocated correctly when using traditional methods. This could be the result of errors in the payment process as well as technical malfunctions.
b) Vulnerability to hacking: Participant P5 highlighted that by using traditional payments methods, sensitive financial data could be unprotected due to the risk of hacking vulnerabilities. This could lead to serious security violations.
c) Fragmented client experience: Participant P2 remarked that traditional payment methods could lead to fragmented client experience which poses possible risks. Disconnected or inconsistent experiences could potentially have a negative effect on client centricity.

II. Risks in blockchain-based payment services:

a) Smart contract consensus reducing risks: Participant P12 mentioned that with the aid of smart contract consensus in blockchain technology, rules are implemented which discourages cheating. This feature of blockchain ensures transaction integrity which contributes to risk reduction.
b) Decreased risk with proper checks: Participant P1 suggested that when accurate checks are in place, risk in blockchain-based payment services are greatly decreased. This infers that risk can be mitigated when blockchain's

transparency and security elements are used correctly.

c) Risk in P2P transactions between wallets: Participant P5 pointed out that within blockchain-based payments transactions, risks may still be evident in peer-to-peer (P2P) transactions between wallets. Whilst blockchain offers security benefits, users may still be exposed to certain risks, such as fraudulent P2P transactions.
d) Payment loss prevention: Participant P12 furthermore noted that it is unlikely for payments to get lost on the blockchain. The transparent and immutable nature of blockchain records aids in the prevention of unallocated payments.
e) Reversibility and control in case of scams: Participant P13 explained that should an unauthorised payment take place as a result of an individual being defrauded, the underlying cash stays within central bank and can be reversed . This feature serves as additional protection to mitigate risk.
f) Dispute prevention and visibility: Participant P12 highlighted that the visibility of the blockchain ledger to everyone and the presence of a single version of the truth can prevent disputes and reduce risks associated with transaction disagreements.
g) No additional risks perceived: Participant P14 suggested that the Bank may not perceive any additional risks associated with blockchain-based payment services beyond those inherent in traditional methods. This viewpoint implies that blockchain technology may not introduce new risks.

In summary, the thematic analysis revealed the following key risk themes:

- Risks in traditional payment services such as fragmented client experience, vulnerability to hacking, and lost payments.
- Risks in blockchain-based payment services include reduced risk with proper checks, risk in P2P transactions between wallets, smart contract consensus reducing risks, visibility and dispute prevention, payment loss prevention, reversibility and control in case of scams, and no additional risks perceived.

Blockchain technology offers several features that can mitigate risks in payment services, including transparency, immutability, and smart contract enforcement. However, some risks, such as those related to P2P transactions, may still exist and require appropriate safeguards.

Finding 73: Risks to the Bank using traditional technology in executing payment services include poor client experience in terms of payments that could get lost and client accounts that could get hacked, resulting in customer liability.

Finding 74: Risks to the Bank using BCT in executing payment services is significantly reduced as fraud is mitigated and operational interruptions are low because BCT develops smart contracts that induce the capability of visible and safe financial transactions.

Interview Question 4C (IQ4C): The time delay in cross-border and cross-currency payments is still challenging. How can BCT make payment services more seamless?

Interview Question 4C focuses on how BCT can make payment services more seamless. The following insights were identified from the participants' responses:

I. Seamlessness in cross-border and cross-currency payments with BCT:

a) Automated processes:
   - P12 mentioned that due diligence automation for new and existing clients and real-time reporting for auditing firms are ways to accelerate cross-border payments and streamline payment services.

b) Real-time settlement:
   - Several participants emphasised that blockchain technology enables real-time settlement of cross-border and cross-currency payments. This feature ensures that transactions are processed almost instantly, eliminating the delays associated with traditional methods.
   - Participants P2, P5, P6, P10 and P14 allude to the speed and near-real-time nature of blockchain-based settlement, highlighting the potential for immediate or significantly faster transaction processing.

c) Immediate verification and validation:
   - Participants mentioned that blockchain can facilitate immediate verification and validation of transactions. This capability reduces the time required to confirm the accuracy and legitimacy of payment transactions.
   - P5 mentioned that as long as all information is correct, blockchain-based transactions should take only a few hours for verification and validation.

d) Transparency enhancement:
   - P3 highlighted that transparency in payment transactions can be improved with the use of blockchain.
   - Some participants acknowledged that the flow of transactions may not automatically be quicker with blockchain, but it notably enhances transparency in the payment process. The transparency feature allows all parties to track and validate entries.

e) Wallet structures for immediate settlement:
    - Participant P1 suggested the creation of wallet structures that represent bank accounts. These wallet structures can facilitate immediate settlement on the blockchain, allowing for the swift transfer of value to recipients.

f) Integration of stable coins:
    - Participant P15 mentioned the integration of stable coin solutions over blockchain, which can provide security features and pave the way for seamless cross-border payments. Stable coins are known for their stability and can be used for various payment purposes.

In summary, the thematic analysis revealed that blockchain technology can contribute to making payment services more seamless in cross-border and cross-currency contexts through the following key mechanisms:

- Enhanced transparency.
- Automation of processes such as due diligence and reporting.
- Real-time settlement and transaction processing Integration of stable coin solutions.
- Innovative wallet structures for immediate settlement.
- Immediate verification and validation of transactions.

These features correspond with the objectives of reducing time delays and improving the efficiency of cross-border and cross-currency payments.

Finding 75: Traditional cross-border payments involve a variety of disparate systems, which results in high transactions fees and delayed processing times. As economies are globalising and digitalising, BCT offers cross-border payments the benefits of speed, near real-time clearing, and access to new markets.

Finding 76: P3 alluded that BCT may not necessarily speed up cross-border payments, but it would offer transparency throughout the cross-border payment process.

Interview Question 4D (IQ4D): In which way will human error be less/more if BCT is applied to payment services?

Interview Question 4D explores the impact of BCT on human error in payment services. The following insights were identified through thematic analysis:

Reduction in Human Error with BCT:

I. Consensus mechanisms and automation:

a) Participants recognised that blockchain operates based on predefined rules and smart contracts, which automate and validate transactions without human intervention. This automated payment process reduces the potential for human mistakes.

b) The consensus mechanism guarantees that multiple nodes in the blockchain network validate transactions, reducing the possibility of discrepancies and incorrect entries.

c) The majority of participants (11 out of 12) believed that implementing blockchain technology in payment services can lead to a reduction in human errors. They attributed this reduction to the consensus mechanisms and automation features inherent to blockchain.

II. Immutable ledger and transparency:

a) Transparency, as enabled by blockchain, reduces the likelihood of errors being overlooked, as all participants can scrutinise transaction details.

b) Participants emphasised that the immutability of the blockchain ledger plays a crucial role in decreasing human oversight. Validated data on the blockchain cannot be deleted or altered without consent, ensuring data accuracy.

III. Elimination of manual processes:

a) Some participants mentioned that blockchain technology eliminates manual processes that are inclined to human error. Manual tasks are replaced by automation reducing the chances of mistakes.

b) The absence of manual data entry, approvals and settlement processes decreases the chances of human errors.

In summary, the thematic analysis revealed that the immutability of the ledger, automation, consensus mechanisms and transparency innate in blockchain technology aids in the reduction of human blunders in payment services. Participants alleged that these facets combined with the removal of manual processes, yields blockchain beneficial for ensuring financial data accuracy and minimising errors. Only one participant expressed scepticism, emphasising that whilst it is not inherent to the technology itself, human error can still occur.

Finding 77: Twelve (12) of the 16 participants believed that human error will be less if BCT is applied to payment services as both automation and artificial intelligence can be used to improve productivity, reduce time and cost associated with manual verification, and provide a seamless payments service offering.

Interview Question 4E (IQ4E): How does BCT prevent fraud in doing payments?

Interview Question 4E explores how BCT prevents fraud in payment services. The following insights were identified through thematic analysis:

Prevention and Reduction of Fraud with BCT:

I. Transparency and immutable ledger:

a) The transparency of transactions on the blockchain allows all participants to view and verify transaction details, making it difficult for fraudulent activities to go unnoticed.
b) The immutability of blockchain data ensures that once a transaction is recorded, it cannot be altered or deleted without consensus, making fraud detection and prevention more effective.
c) The majority of participants (9 out of 11) emphasised that blockchain technology's transparency and the immutability of its ledger play a crucial role in preventing and reducing fraud.

II. Real-time monitoring and traceability:

a) Fraud investigations become less cumbersome as an audit trail facilitates the tracing of transactions on the blockchain.
b) The window period for fraudulent actions are significantly reduces as suspicious activities and transactions are swiftly picked up with real-time monitoring.
c) Several participants highlighted that fraud detection would become more efficient with blockchain'.

III. Digital identity and secure payments:

a) Blockchain can enhance security and reduce fraudulent transactions, by changing traditional account numbers to secure digital identities.
b) Some participants mentioned the use of self-sovereign identity (SSI) and digital identity solutions on blockchain to prevent identity fraud and fraudulent payments.

IV. Combining fraud prevention tools with blockchain:

a) A few participants suggested that specialised fraud prevention tools together with blockchain solutions, serves as an effective combination in reducing fraud in payment services.

V. **Fraud cannot be prevented completely:**

a) They highlighted that like any technology, blockchain can be misused for fraudulent activities, but its transparency makes fraud more traceable.
b) A minority of participants (3 out of 11) acknowledged that while blockchain can reduce fraud, it cannot completely prevent it.

In summary, the thematic analysis revealed that blockchain technology's transparency, immutable ledger, real-time monitoring, traceability, and integration with identity solutions contribute to the prevention and reduction of fraud in payment services. While participants recognised blockchain's potential to enhance security and deter fraud, some acknowledged that fraud cannot be entirely eliminated, but it can be significantly reduced through blockchain's features and real-time capabilities.

Finding 78: Seven participants agreed that fraud can be prevented using BCT tools such as shared ledger, artificial intelligence and self-sovereign identity as well as applying the characteristics of BCT architecture, namely immutability and quick settlement.

Finding 79: Contrarily to finding 78, seven participants said that BCT cannot prevent fraud, but it can most definitely reduce it based on the characteristics of BCT architecture, which include transparency and a consensus algorithm.

Interview Question 4F (IQ4F): In traditional banking, the services of intermediaries e.g., SWIFT are required. How does BCT change the dynamics of intermediaries?

Interview Question 4F explores how BCT changes the dynamics of intermediaries in traditional banking. The following insights were identified through thematic analysis:

Impact on intermediaries:

I. **Elimination of intermediaries:**

a) The participants envisioned a future where blockchain-based systems can replace traditional intermediaries, streamlining the payment process.
b) Some participants suggested that blockchain technology has the potential to completely eliminate the need for intermediaries like SWIFT.

II. **Blockchain as infrastructure:**

a) Participants emphasised that blockchain itself is not an organisation but a technology infrastructure.
b) They saw the possibility of traditional intermediaries such as SWIFT adopting blockchain technology to enhance their services and remain relevant.

III. **Intermediaries embracing blockchain:**

a) Some participants noted that traditional intermediaries are not willing to be left behind in the blockchain revolution.
b) They highlighted efforts by intermediaries to adopt blockchain solutions like Hyperledger, indicating a willingness to incorporate blockchain into their existing systems.

IV. **Blockchain as a replacement for financial services:**

a) Participants expressed the view that blockchain can replace not only SWIFT but also traditional payment methods like Visa and MasterCard.
b) They saw blockchain as the underlying technology that can provide financial services directly to clients, reducing the reliance on traditional intermediaries.

In summary, the thematic analysis revealed that blockchain technology has the potential to disrupt the role of intermediaries in traditional banking. Participants envisioned scenarios where intermediaries may be eliminated or adapted to incorporate blockchain technology into their (intermediary bodies) services. Some participants emphasised that blockchain itself can serve as the infrastructure for financial services, reducing the need for traditional intermediaries like SWIFT.

Finding 80: The general feeling is that BCT can help to create a favourable environment where payments between parties—P2P, B2B—can deal with each other directly, with minimal or zero involvement of the middleman (SWIFT).

Finding 81: SWIFT (Society for Worldwide Interbank Financial Telecommunications) could very well explore and adopt BCT in their operation.

Interview Question 4G (IQ4G): The Bank effects monthly payments, for example to SARS. If the Bank utilises BCT, must SARS also be blockchain-enabled?

Interview Question 4G explores whether SARS (South African Revenue Service) needs to be blockchain-enabled if the Bank utilises BCT for monthly payments. The following insights were identified through thematic analysis:

I. **SARS blockchain integration:**

a) Not necessary for SARS:
- The majority of participants (11 out of 12) believed that SARS does not need to be blockchain-enabled for the Bank to utilise blockchain technology for monthly payments.

- They likely see blockchain technology as a backend solution that the Bank can use to enhance its payment processes without requiring SARS to undergo blockchain integration.

b) Conditional integration for SARS:

- Only one participant (P3) had a different perspective, suggesting that SARS may need to be blockchain-enabled if they (SARS) intend to use the server or system that utilises blockchain technology. This response implies a conditional approach, where SARS' integration with blockchain depends on their specific requirements or use of the blockchain-based server.

In summary, the thematic analysis revealed that the majority of participants do not believe it is necessary for SARS to be blockchain-enabled for the Bank to implement blockchain technology for monthly payments. They view blockchain as a tool that the Bank can use independently to optimise its payment processes. However, one participant suggested a conditional integration approach based on SARS' intended use of the blockchain system.

Finding 82: Most participants responded that a partner, e.g., SARS, does not need to be blockchain-enabled to interact with the Bank.

Finding 83: P3 differed and felt that partners need to be blockchain-enabled to have access to the server.

Interview Question 4H (IQ4H): Is cybercrime a concern in respect of blockchain?

Interview Question 4H investigates whether cybercrime is a concern in relation to blockchain. The following insights were identified through thematic analysis:

I. Cybercrime concerns in blockchain:

a) High cybercrime concern:

- The majority of participants (13 out of 15) expressed significant concerns about cybercrime in the context of blockchain.
- They acknowledged that cybercriminals may target blockchain systems, and security measures need to be in place to mitigate these risks.

II. Blockchain as a security measure:

b) Blockchain as a cybersecurity solution:

- Two participants (P15 and P16) held a different perspective, suggesting that blockchain technology can actually serve as a cybersecurity measure.

- They emphasised that blockchain enforces trust through inbuilt algorithms and complexity, making it difficult for cybercriminals to attack.
- Additionally, they mentioned the use of blockchain for preventing cybercrimes related to digital identity and DNS attacks.

In summary, the thematic analysis revealed that while the majority of participants expressed concerns about cybercrime in the context of blockchain, two participants viewed blockchain as a potential solution to cybersecurity issues. They believe that blockchain's inherent security features can make it challenging for cybercriminals to exploit.

Finding 84: Most participants felt that cybercrime is an ongoing concern in respect of BCT considering the lucrative nature of cybercrime and the ingenuity of criminals to plot attacks.

Finding 85: Two participants disagreed that cybercrime is a concern as the method of cryptography and the process of encryption make it difficult for cybercriminals to attack.

Interview Question 4l (IQ4l): What would be the back-up plan should there be a system-wide blockchain financial collapse or fail?

Interview Question 4l investigates if a back-up plan is in place, should there be a system-wide collapse or fail. The following insights were identified through thematic analysis:

I. Enhancing security

a) All 16 participants advised that it is highly unlikely for all nodes in a blockchain network to fail simultaneously as blockchain networks are designed to be resilient. provided there are enough nodes to validate transactions and maintain a copy of the blockchain.

4.3 Summary of findings

All findings listed below in all probability have answered the research questions.

Table 4.7:Summary of Findings

No.	Finding	RQ
1	The Bank started exploring BCT about seven years ago around payments and letters of credit.	RQ3
2	About five years ago BCT has gone live in certain areas of the banking operation.	RQ3
3	Whilst the Bank has an organisational strategy in place, some participants felt that there is no clear technology strategy in place.	RQ1

No.	Finding	RQ
4	Other participants argued that there is a technology strategy in place because of the changing landscape of technology.	RQ1
5	There is definite innovation and technological boundary-pushing to enable future readiness through technology implementation to ensure inclusive and sustainable technological advancement within the Bank.	RQ2
6	The motivating factors that encouraged the exploration of blockchain technology were to learn new things so that the Bank has an understanding of how the wall of technology is changing and not get left behind.	RQ3
7	The use of BCT has the potential to change the business model and business performance.	RQ2
8	The use of BCT in respect of payment services definitely improves the Bank's bottom line by decreasing costs and improving efficiencies.	RQ2
9	It is important for the Bank to be aware of what the market could possibly be aware of.	RQ3
10	Compliance, governance and regulation from a South African perspective as well as from a global perspective is a huge challenge in the adoption of BCT in payment services.	RQ1
11	The acceptance of BCT to certain levels of management is challenging because of fear of the negative aspects around the technology, especially cryptocurrencies.	RQ1
12	The Bank seems fearful of exploring and would rather wait for others to test BCT technology.	RQ1
13	There is a lack of understanding from a technical and business perspective regarding the benefits blockchain technology can bring to the business.	RQ1
14	The current payments infrastructure is based on decades-old technology, which is complicated and challenging to merge with newer technology.	RQ1
15	Partnership with other entities is lacking, which is preventing the organisation from accelerating innovation and the delivery of powerful digital services that BCT offers.	RQ1
16	Implementation on a production level scale is very costly.	RQ1
17	It is important for the Bank to establish control systems and levels of comfort with regulators to ensure visibility and making certain that respect for the laws of the country as well as other countries are not compromised in terms of compliance, governance and regulation.	RQ3
18	Collaboration and building strong partnerships with other banks internationally are key to overcoming some of the challenges faced with in payment services.	RQ3
19	Change in organisational culture, specifically change in thinking, will help in solving some of the challenges.	RQ1
20	Embracing BCT in payment services is still challenging, and investing money in experimentation is slow.	RQ1
21	It is important for the Bank to have market intelligence about what is happening in the existing market, for competition and growth.	RQ2
22	BCT can strengthen data privacy in financial transactions by using the process of cryptography to enable encryption.	RQ2
23	BCT can strengthen data privacy in financial transactions by using an identity management system called Self-Sovereign Identity (SSI).	RQ2
24	BCT can strengthen data privacy in financial transactions by using private networks.	RQ2
25	On the other hand, P2 was not sure that BCT could strengthen data privacy in financial transactions.	RQ1
26	Participants P8 and P11 argued that blockchain technology does not provide data privacy.	RQ3
27	P13 alluded to the fact that data should not be private as it hinders the process of monitoring transactions.	RQ1
28	Eleven (11) participants felt that the Bank has a solution in place in terms of interoperability by using APIs and applying consensus mechanisms for the different silos within the Bank to interact.	RQ3

No.	Finding	RQ
29	P3 felt that there is framework in place to unite the different silos.	RQ3
30	Any new technological adoption entails a certain measure of risk.	RQ1
31	P13 argued that it is a mistake and a big risk to not transition to BCT.	RQ1
32	Risks arise from pioneering ahead of national and international regulatory frameworks.	RQ1
33	Current compliance, governance and regulation is the opposite of what BCT offers in payment services in respect of data privacy and retention period of information.	RQ1
34	With the use of APIs, there would be no impact on the integration of legacy architecture and new business models.	RQ3
35	With the use of BCT, there would not be a need for integration as it could cancel entire processes and expunge existing legacy systems.	RQ3
36	P13 felt that integrating BCT into legacy architecture was not advisable as it does not align with the purpose of what BCT is meant to fulfil.	RQ3
37	There appears to be a difference of opinion as some participants felt assimilation into the current technology stack can be achieved through pilot projects and the use of APIs, whilst others felt that legacy systems should not be integrated but that brand new architecture should be introduced to avoid going back to the old way of working.	RQ3
38	There was a general feeling among the participants that historical data would be transferred to the new technology.	RQ3
39	P12 stated that the Bank has to comply with legislation to hold information for five years and for this reason, the existing databases will need to be held for five years.	RQ3
40	Two participants disagreed that historical data should be onboarded on a blockchain; instead, it should be stored off-chain.	RQ3
41	The general feeling of the participants was that the Bank is very conscious of their carbon footprint, hence their use of BCT would not have a negative effect on the environment, especially because there is no need for mining in the banking industry.	RQ2
42	P11 alluded to the fact that the Bank would contribute to a healthier environment by discontinuing legacy architecture and replacing it with BCT.	RQ2
43	There are not enough experts within the Bank to manage BCT.	RQ1
44	The information received is conflicting in that some participants felt that the adoption of BCT would decrease staff, whilst others felt it would create a need for more staff. Contrarily, some felt it would not have any effect on staff compliment. Furthermore, some felt it would initially cause an increase and thereafter a decrease.	RQ1
45	Information received in respect of the broader staff compliment being upskilled in respect of BCT was clashing as half felt that is was a necessity and the other half felt it was non-essential.	RQ1
46	There is a lack of financial resources to sandbox legacy technology	RQ1
47	There is a shortage of BCT skills set particularly in the payments environment.	RQ1
48	Teams within the Bank are not open to collaboration to integrate the legacy systems.	RQ1
49	Regulation is an ongoing challenge as there is no clear way of managing BCT going forward.	RQ1
50	Management does not have strategy in place to embrace BCT.	RQ1
51	Employees are resistant to change due to lack of clarity and reasons for the change.	RQ1
52	The educational piece is lacking hence employees do not have a clear understanding of BCT.	RQ1
53	BCT can generate revenue for the Bank through potentially new products or services e.g., digital asset custody, digital asset loans and deposits.	RQ2
54	With the use of BCT, services could be more effective, which could lead to client expansion, which, in turn, could stimulate revenue growth.	RQ2
55	BCT optimises the management of infrastructure, which reduces costs significantly as payment services are maintained and controlled by a centralised single entity.	RQ2

No.	Finding	RQ
56	BCT effectively automates portions of audit processes, which reduces the cost of monitoring since the accuracy of all transactions in the information systems will be time-stamped with real-time audits trails.	RQ2
57	BCT reduces cost in P2P payments as less human oversight is required.	RQ2
58	P2P payments require costly network and IT infrastructure support, which, with the use of BCT, can be reduced significantly.	RQ3
59	Processing time for P2P payments will be reduced, which ultimately reduces banking costs.	RQ3
60	BCT reduces the need for third party correspondent banking systems and SWIFT in cross-border payments by using smart contracts that reduce costs and subsequently enable exploration of different pricing models for clients.	RQ3
61	BCT has the potential to impact all record-keeping processes, including the way transactions are initiated, processed, authorised, recorded and reported.	RQ2
62	The Bank believes that adopting BCT will give the organisation a competitive advantage.	RQ2
63	Early adoption of the technology can give the Bank a competitive advantage by optimising on transaction costs, thereby strengthening its place in the market.	RQ2
64	Competitive advantage to the Bank does not necessarily mean being better than others, but rather fostering strategic alliances, thereby creating collaborative advantage, which can be utilised for the fuller value-creating potential of the broader ecosystems wherein they operate.	RQ3
65	BCT can maintain digital integration between customers and partners.	RQ3
66	BCT can unlock the gate to establish an autonomous open and scalable payment network system, providing operational efficiency and performance excellence	RQ3
67	The difficulty in executing payment services lies in the fact that regulators globally are finding it difficult to structure a clear framework to govern BCT, which is designed to be self-regulating and self-maintaining. This is prohibiting the Bank from gravitating to an innovative approach to launch successful initiatives as they are currently compelled to take on a risk-averse approach.	RQ1
68	Legacy systems for payment services were developed many years ago, which currently lack the ability to keep up with modern technologies. Modern payment solutions help to scale a business, but as a result of the Bank being at the core of their overall banking architecture, making changes to their systems would affect daily operations. However, the delay in making changes ultimately hinders business growth.	RQ1
69	Inertia (persistence to use incumbent systems whilst there are better alternatives), appears to be not only applicable to individuals, but also to organisations.	RQ1
70	The formation of collaborative innovation partnerships to build an effect payment network is challenging.	RQ1
71	Traditional payment systems pose challenges such as lack of speed, downtime, scaling issues, throughput management and wrong beneficiary details, especially with cross-border payments.	RQ1
72	Internal processes to effect payment services are long-winded.	RQ1
73	Risks to the Bank using traditional technology in executing payment services include poor client experience in terms of payments that could get lost and client accounts that could get hacked, resulting in customer liability.	RQ1
74	Risks to the Bank using BCT in executing payment services is significantly reduced as fraud is mitigated and operational interruptions are low because BCT develops smart contracts that induce the capability of visible and safe financial transactions.	RQ2
75	Traditional cross-border payments involve a variety of disparate systems, which results in high transactions fees and delayed processing times. As economies are globalising and digitalising, BCT offers cross-border payments the benefits of speed, near real- time clearing, and access to new markets.	RQ2
76	P3 alluded that BCT may not necessarily speed up cross-border payments, but it would offer transparency throughout the cross-border payment process.	RQ2

No.	Finding	RQ
77	Twelve (12) of the 16 participants believed that human error will be less if BCT is applied to payment services as both automation and artificial intelligence can be used to improve productivity, reduce time and cost associated with manual verification, and provide a seamless payments service offering.	RQ2
78	Seven participants agreed that fraud can be prevented using BCT tools such as shared ledger, artificial intelligence and self-sovereign identity as well as applying the characteristics of BCT architecture, namely immutability and quick settlement.	RQ2
79	Contrarily to finding 78, seven participants said that BCT cannot prevent fraud, but it can most definitely reduce it based on the characteristics of BCT architecture, which include transparency and a consensus algorithm.	RQ2
80	The general feeling is that BCT can help to create a favourable environment where payments between parties—P2P, B2B—can deal with each other directly with minimal or zero involvement of the middleman namely SWIFT.	RQ3
81	SWIFT (Society for Worldwide Interbank Financial Telecommunications) could very well explore and adopt BCT in their operation.	RQ3
82	Most participants responded that a partner, e.g., SARS does not need to be blockchain-enabled to interact with the Bank.	RQ3
83	P3 differed and felt that partners need to be blockchain-enabled to have access to the server.	RQ3
84	Most participants felt that cybercrime is an ongoing concern in respect of BCT considering the lucrative nature of cybercrime and the ingenuity of criminals to plot attacks.	RQ1
85	Two participants disagreed that cybercrime is a concern as the method of cryptography and the process of encryption make it difficult for cybercriminals to attack.	RQ3
86	All 16 participants advised that it is highly unlikely for all nodes in a blockchain network to fail simultaneously as blockchain networks are designed to be resilient. Whilst nodes are expected to go offline from time to time, the network can continue to function provided there are enough nodes to validate transactions and maintain a copy of the blockchain.	RQ3

4.4 Summary

Chapter Four provided a detailed discussion of the thematic analysis and study findings. The report started with an introduction and a summary of the case study followed by a detailed review of the interview responses and transcribed data. The analysis of the research findings led to the identification of categories and themes aligned with the research questions.

The next chapter will delve into the themes derived from the findings, linking them to the research questions and objectives.

CHAPTER FIVE: DISCUSSION OF RESULTS

5.1 Introduction

Blockchain technology has advanced into a transformative force that questions the key principles of traditional payment systems. As with any transformative innovation, it creates a complex interplay of risks, benefits and implications. This technology offers unique prospects to enhance cost and operational efficiency, increase transparency, expand the ecosystem, reduce fraud, and provide a competitive edge – capabilities that were previously improbable within the structure of traditional banking systems. Whether one perceives blockchain as a solution or a problem, it definitely has affected the future of payment services.

Semi-structured interviews were conducted with participants as discussed in Chapter 4, and important insights were listed and labelled as findings. By carefully following the steps of the thematic analysis technique, findings were initially grouped into categories. Further analysis of the categories led to the identification of three core themes and twelve sub-themes (Table 5.2) encapsulating the overall findings of the study.

For ease of reading, the aim of the study, research objectives and research questions are re-stated below in Table 5.1.

Table 5.1: Re-stating the aim, research objectives and research questions

Aim of the Study	Research Objectives	Research Questions
To determine the effect of blockchain technology on payment services in a South African Commercial Bank.	• To identify and analyse the key challenges of applying blockchain technology in the South African banking industry. • To explore the main benefits of blockchain on payment services in the South African banking sector. • To assess the effect of blockchain technology on payment services at a South African Commercial Bank.	1. What are the key challenges of applying blockchain technology in the South African banking industry? 2. What are the main benefits of blockchain for payment services in the South African banking sector? 3. How does blockchain technology impact on payment services at a South African Commercial Bank.

The discussion of the themes is aligned with the research questions (RQs) and interview questions (IQs), establishing connections to the existing literature within the field. The analysis of sub-themes focuses on addressing the research questions, providing insights to resolve the identified research problem and achieve the stated objectives.

5.2 Discussion of themes and sub-themes

Table 5.2: Themes and sub-themes

Theme	Sub-themes
1. Challenges	1.1 Regulatory Compliance
	1.2 Data Privacy Concerns
	1.3 Legacy System Integration
	1.4 Change Management
2. Benefits	2.1 Cost Reduction
	2.2 Income Generator
	2.3 Cross Border Efficiency
	2.4 Competitive Advantage
3. Effects	3.1 Operational Efficiency
	3.2 Customer Experience
	3.3 Transaction Transparency
	3.4 Fraud Prevention

5.2.1 Theme 1: Challenges

For Theme 1, four sub-themes were derived. Each sub-theme highlights dependencies or interactions, such as how regulatory compliance affects data privacy concerns, while both influence legacy system integration.

5.2.1.1 Sub-theme 1.1: Regulatory Compliance

Despite the immense potential offered by blockchain technology, navigating regulatory compliance within the banking sector remains challenging. The overall lack of a regulatory reporting infrastructure creates uncertainty, which, in turn, impedes the adoption, integration and growth of the technology. Regulatory Boards across the globe still tend to cling to traditional practices, resulting in the change of laws and governance to be reactive rather than proactive. Whilst these challenges are present, the Bank has strategies in place to overcome the challenges. These strategies include close collaboration with regulators, engaging with them to build controls, conduct rigorous evaluation of the blockchain technology, and establish levels of comfort to ensure compliance with national and international laws.

According to Adedoyin Tolulope Oyewole *et al*. (2024:646),

> "Balancing innovation with compliance in the FinTech sector requires a multifaceted approach that encompasses regulatory foresight, ethical consideration, and technological adaptability. Regulators and policymakers must navigate the 'Innovation Trilemma' by developing clear, simple and flexible regulatory frameworks that accommodate the rapid pace of technological advancements while safeguarding market integrity and consumer protection".

Table 5.3: Sub-theme 1.1: Regulatory Compliance

Theme 1: Challenges		
Sub-theme 1.1: Regulatory Compliance		
P#	**Participant Insight**	**Literature Source**
P3	Regulatory reporting infrastructure	Lindman *et al*. (2020) state that blockchain has become more prevalent across the globe, and this has sparked an increased interest among regulatory bodies and political entities to integrate the technology into their regulatory frameworks. Regulatory reporting requirements are often complex and differ across various jurisdictions.
P6	Uncertainty in regulatory environment	On the other hand, Bennet *et al*. (2024) argue that regulatory bodies are delayed in developing clear and comprehensive guidelines for financial institutions to develop robust regulatory frameworks and technical solutions that foster innovation while ensuring compliance and security in the implementation of the technology.
P8	Resistance to regulatory change	Furthermore, De Filippi *et al*. (2022) maintain that the absence of consistency in practices by regulators is another point of resistance to the adoption intention of organisations.

P=Participant

5.2.1.2 Sub-theme 1.2: Data Privacy Concerns

The Bank is governed to comply with regulations both nationally and internationally to ensure robust client data privacy whilst simultaneously inducing innovation. Notwithstanding a minority of participants argued that blockchain technology, by design, may not necessarily cater for data privacy, most participants perceived blockchain technology as having the potential to strengthen data privacy using data encryption and self-sovereign identity (SSI) within the strict legislative and banking governance environment in South Africa. Rane *et al*. (2024a:136) support this idea by stating that data privacy can be enhanced in the financial industry with blockchain technology as it provides tamper-proof records of transactions open for validation and review at any point in time and that "this fosters trust, as clients are guaranteed that their confidential information is protected from alteration or exploitation".

Table 5.4: Sub-theme 1.2: Data Privacy Concerns

Theme 1: Challenges		
Sub-theme 1.2: Data Privacy Concerns		
P#	**Participant Insight**	**Literature Source**
P2	Doubt regarding data privacy improvement	Wang *et al*. (2020) caution that blockchain technology, by its very nature, is unable to protect a users' privacy unequivocally.
P1, P5, P6, P8, P11, P14	Data encryption	The absence of central authority was the impressive design principle in the initial hypothesis of blockchain technology. Authentication is undertaken through the utilisation of cryptographic keys, which sanctions trust without reliance on third-party intermediaries (Chowdhury *et al*., 2021). Additionally, cryptographic mechanisms are applied in data storage processes to improve the security of information (Chowdhury *et al*., 2021).
P11, P14	Self-sovereign identity (SSI)	Gans *et al*. (2022) agree with findings of other studies that blockchain technology gives autonomy to individuals to securely share their personal data for purposes of their choice and to engage with private companies through SSI. A digital identity can be created and used to

Theme 1: Challenges		
Sub-theme 1.2: Data Privacy Concerns		
P#	**Participant Insight**	**Literature Source**
		authenticate online transactions through an SSI blockchain-based application, which enables individuals to generate an encrypted identity and control their own data.

P=Participant

5.2.1.3 Sub-theme 1.3: Legacy System Integration

The findings revealed that integrating blockchain technology with legacy systems appears to depend on the specific use cases, approach and strategies adopted by the Bank to leverage blockchain technology. The participants presented a diverse viewpoint on how blockchain technology may affect the integration of legacy architecture and new business models as listed below; however, Salzano *et al*. (2023:3) state that "according to the Legacy Dilemma, we must trade off the cost of continuing to cope with the legacy system against the investment needed to improve it and the benefit of easier subsequent maintenance".

- Some participants believed that BCT can be considered as an add-on to complement existing systems and processes, with the use of integration methods like APIs and interoperability.
- Others argued that the need for integration is not required as BCT can potentially replace or rebuild legacy systems to support new business models.
- One participant felt that careful consideration should be exercised, suggesting that blockchain may not fit into legacy architecture due to misalignment with its intended goals.

Table 5.5: Sub-theme 1.3: Legacy System Integration

Theme 1: Challenges		
Sub-theme 1.3: Legacy System Integration		
P#	**Participant Insight**	**Literature Source**
P1, P2, P8, P9	Blockchain as complementary integration	When digital technology such as blockchain is added as a complementary value to new business models, the digital technology boosts the value proposition and furthermore compounds the economic value by magnetising a broader client base (Böttcher *et al*., 2024).
P3, P5, P7	No need for integration	Bokolo (2024) is of the opinion that digital services of modern society are met through existing state-of-the- art blockchain infrastructure designed in such a way that it operates as a stand-alone digital platform.
P13	Caution against integration (not suitable)	Bokolo (2022) also identified that there is still a gap between practice and theory in respect of interoperability requirements and capabilities, hence integration becomes complex.

P=Participant

5.2.1.4 Sub-theme 1.4: Change Management

John Maxwell laments that “change is inevitable. Growth is optional” (AZ Quotes, 2024:1). The findings revealed that management faces the challenge of staff who resist adopting and adapting to new solutions, thereby stunting growth for themselves within the work environment. The underlying technology for cryptocurrency is blockchain. Staff battles with the misconception of cryptocurrency, resulting in resistance to embrace this technology. Another challenge that management faces is cost saving, given the volatile economic climate. This hinders the allocation of funds to explore new technologies. Another burning issue that management encounters is the presence of silos and barriers between departments, which impedes the smooth transition of technology within the organisation.

Table 5.6: Sub-theme 1.4: Change Management

Theme 1: Challenges		
Sub-theme 1.4: Change Management		
P#	**Participant Insight**	**Literature Source**
P2	Resource allocation and capital constraints	The challenge of deploying a blockchain solution within the banking sector is that it requires a substantial investment to cover the expensive cost for research and development, infrastructure, input regarding the software and hardware required for its initial launching, system design, operational costs, and maintenance and support costs (Vijai & Nivetha, 2020; Taherdoost, 2022).
P5	Resistance and misconception	Resistance to innovation change is two-fold. One being passive resistance, where there is a tendency to resist change in general and/or being content with how things currently stand. Active resistance on the other hand arises from rejection of an innovation based on negative viewpoints, intentions and activities (Friedman & Ormiston, 2022). Furthermore, Shojaei and Burgess (2022) comment that once innovation resistance is overcome, only then will the adoption of innovation grow.
P13	Silos and barriers	The silo organisational structure within the banking industry is a definite obstruction to integration within functional units as each business unit has its own data silos secured by firewalls and its own technology team, resulting in lack of alignment of goals and priorities (Teisserenc & Sepasgozar, 2021).

P=Participant

5.2.2 Theme 2: Benefits

For Theme 2, four sub-themes were derived. Links between benefits illustrate where one benefit may strengthen another. For example, improved transaction speed and enhanced record keeping of transactions contribute to customer satisfaction.

5.2.2.1 Sub-theme 2.1: Cost Reduction

It is crucial for any company, including the Bank, to run a cost-efficient operation. This undoubtedly ensures sustainability by lowering costs and success by increased profit margins, which release revenue to facilitate growth. The findings revealed that cost reduction, through lower-priced transaction costs and infrastructure savings, improves customer

relationships and increases service usage. Furthermore, processes are streamlined, resulting in reduced operational costs for the Bank. These processes include improved transaction speed and enhanced record keeping of transactions. Choithani *et al*. (2024:126) state, “there is no doubt that, in addition to the key cost reduction effects of using AI in banking, it has the competence to change the work environment”.

Table 5.7: Sub-theme 2.1: Cost Reduction

Theme 1: Challenges		
Sub-theme 2.1: Cost Reduction		
P#	**Participant Insight**	**Literature Source**
P4, 12, P13	Cost reduction and efficiency with inherent costs savings, reduction in processing time, and easier peer-to-peer payments.	Saripalli (2021) emphasises that the inherent cost savings of blockchain technology remove the timeous and costly function of intermediaries in the processing and reconciliation of transactions. Furthermore, processing time is fast-tracked as instant reconciliation occurs through consensus mechanisms and then recorded into a single version of truth, i.e., distributed ledger. Additionally, the focus on peer-to-peer payments can also drastically reduce bank related costs as blockchain technology combines the steps of authorisation, clearing and settlement into instant settlement mitigating counter-party risk).

P=Participant

5.2.2.2 Sub-theme 2.2: Income Generator

Income generation for any company is pivotal for its existence. The findings revealed that with the use of blockchain technology, the Bank can generate strong revenue streams. This enables the exploration of new markets and services, which enhances client centricity. Blockchain technology also reduces transaction costs, and the efficiency in streamlining processes reduces infrastructure costs, which ultimately increases income as operational expenses are less. Hossein *et al*. (2024:257) state that “it is necessary for companies and businesses to know the new methods of business income generation under emerging technologies and to act based on them in today’s highly competitive world”.

Table 5.8: Sub-theme 2.2: Income Generator

Theme 2: Benefits		
Sub-theme 2.2: Income Generator		
P#	**Participant Insight**	**Literature Source**
P6	Introduction of new services	Banks have slacked in producing innovative banking products and services. But this can be turned around by giving clients increased value through digital asset exchange as well as exchanging multiple other financial assets on or through a blockchain network. This will assist the banking sector with restructuring lucrative opportunities and producing new revenue channels (Kumari & Devi, 2022)
P7, P8, P14, P16	Cost reduction and efficiency	Noor (2022) states that infrastructure, procedures and competencies are the three pillars of strength that institute the success of any organisation. Blockchain technology has the potential to increase productivity, improve client centricity and reduce overheads, thereby strengthening the pillars.

P=Participant

5.2.2.3 Sub-theme 2.3: Cross-Border Efficiency

Cross-border payments done via the traditional methods are cumbersome, time-consuming, and costly. According to Sanyaolu *et al*. (2024:45), "blockchain technology has emerged as a transformative tool in the banking sector, significantly enhancing transaction efficiency through real-time processing, cost reduction, and improved cross-border transactions". The findings revealed that the Bank is actively working on the solutions that blockchain technology offers, e.g., automation through smart contracts, elimination of third-party correspondent banking, and SWIFT and cloud-based solutions and distributed resources. Together, these dynamics will contribute to the benefits, as stated by Sanyaolu *et al*., in the context of international and cross-border payments.

Table 5.9: Sub-theme 2.3: Cross Border Efficiency

Theme 2: Benefits		
Sub-theme 2.3: Cross Border Efficiency		
P#	**Participant Insight**	**Literature Source**
P1	Automation through smart contracts	The major upgrade of blockchain-based smart contracts is that it can function without a central point of authority, which enables autonomous execution within pre-arranged settings and ensures continual service availability (Garg & Rao, 2023).
P2	Elimination of third-party correspondent banking and SWIFT	The major upgrade of blockchain-based smart contracts removes the need for trusted third parties, thereby reducing costs in international and cross-currency payments (Hewa *et al*., 2021).
P7	Cloud-based solutions and distributed resources	Traditional on-premises data centres require substantial initial and ongoing financial investments, however, banks and other financial organisations can utilise cloud-based solutions on a pay-as-you-go system, which not only saves money, but also allows for better use of available resources to brainstorm suggestions, and speedily build and test software to offer clients outstanding technological solutions (Łasak & Wyciślak, 2023). Despite these positives, Alshinwan *et al*. (2023) point out that confidence in cloud-based solutions are negatively affected by difficulties related to data migration to the cloud-based infrastructure, duration of data retention, possible human errors as cloud coding are written by humans, and the added cost of providing tighter processes and policies to secure personal user data. Swathi and Pahuja (2023) counter-argue that cloud providers are better equipped against security threats through advancements in encryption and multi-factor authentication, therefore the cloud can be declared as a safe haven for sensitive financial data.

P=Participant

5.2.2.4 Sub-theme 2.4: Competitive Advantage

Rane *et al*. (2024b:1) state: "It is found from emerging trends that only those businesses which are using sophisticated technologies such as Artificial Intelligence, Blockchain, Big Data Analytics, Cloud Computing, and Internet of Things are now gaining competitive advantage through resilience, innovation, and customer-centricity". Investing in innovation expands the operations of a business, which can help them stay ahead of their competitors.

The findings revealed that blockchain technology can provide the Bank with a competitive edge by lowering transaction costs, enhancing user experience, enhancing transparency and immutability, promoting collaboration, and fostering an inclusive partnership approach. Furthermore, cross-selling, exposure to new business relationships and opportunities, facilitation of collaboration in a mutually beneficial environment, and the creation of cost-effective, closed-loop ecosystems are all added value in gaining a competitive advantage.

Table 5.10: Sub-theme 2.4: Competitive Advantage

Theme 2: Benefits		
Sub-theme 2.4: Competitive Advantage		
P#	**Participant Insight**	**Literature Source**
P1, P7, P9, P15	Ways in which BCT can provide a competitive advantage: a) Low transaction costs b) Enhanced user experience c) Transparency and immutability d) Value in collaboration e) Inclusivity and partnerships	Improved competitiveness in the banking and financial sector can be achieved through combining the task-technology and technology acceptance theory, which a) offers cost savings; and b) has the potential to enhance customer experience (Kim & Hyun, 2023). Furthermore, Kim and Shin (2019) posit that the spin-off of customer trust in the blockchain solution generates c) transparency and traceability of information, which can be another source of competitive advantage; and d) "collaboration can strengthen competitive advantages by increasing firm-specific skills and realising economies of scale". In relation to inclusivity and collaboration, (Bedin et al., 2021) state that organisations with horizontal, vertical or both types of relations that offer essential or non-essential services have a common goal, which is to create value for their client base. Blockchain technology enables organisations to form strategic alliances, merge similar abilities, and combine different businesses with different purposes to serve existing clients through a single platform that can improve client satisfaction. Additionally, strong partnerships have the opportunity to reach new clients, which are hard to find when operating in isolation

P=Participant

5.2.3 Theme 3: Effects on Payment Services

For this Theme 3, four sub-themes were derived. Whilst a number of challenges may affect the Operational Efficiency sub-theme, there are benefits that directly enhance sub-themes 3.2 (Customer Experience) and 3.3 (Transaction Transparency).

5.2.3.1 Sub-theme 3.1: Operational Efficiency

The use of blockchain technology in banking payment services presents operational hurdles that require attention. Odunayo Adewunmi Adelekan *et al*. (2024:326) emphasise that "the operational challenges in implementing AI and blockchain technologies are significant and multifaceted. Addressing these challenges requires a comprehensive approach that includes technical and infrastructural development, legal and regulatory adjustments, and ensuring compatibility with existing systems". The findings revealed that volume and infrastructure

strain, lack of understanding and education, scaling and network challenges, and authorisation and authority levels, among other challenges, are setbacks in operating efficiently. The Bank is cognisant that these challenges need to be addressed to facilitate the successful adoption of blockchain technology.

Table 5.11: Sub-theme 3.1: Operational Efficiency

Theme 3: Effects on Payment Services		
Sub-theme 3.1: Operational Efficiency		
P#	**Participant Insight**	**Literature Source**
P1, P2, P3, P5, P6, P8, P9, P10, P12, P13, P14, P15, P16	Challenges: a) Regulation and compliance b) Legacy architecture c) Scaling and network challenges d) Volume e) Infrastructure strain f) Lack of understanding and education	Sachitra and Dayaratna (2023) state that coherent with (a) **regulation and compliance**, existing (b) **legacy architecture** is a huge constraint in the banking environment as the **integration** of old systems with new technology poses compatibility issues. The nature of distributed ledger is to permanently store information that will induce (c) **scalability** issues due to a high (d) **volume** of transactional data. Apart for the scalability issue, integrating blockchain into other banking services requires the interaction of different networks, which could negatively influence the decision-making process resulting, in (e) **infrastructure strain.** Kaushal *et al*. (2021) highlight that despite the popularity of blockchain technology, there is a lack of understanding of the potential it offers. Furthermore, Themistocleous *et al.* (2020)emphasise that there is a need for well-structured blockchain (f) educational programmes as well as strong co-ordination between business units to initiate the overall adoption of the technology

P=Participant

5.2.3.2 Sub-theme 3.2: Customer Experience

Customer service and customer experience are different topics, but equally important (Talkative, 2022). For the purpose of this study, the focus is only on customer experience using blockchain technology for payment services. Doing payments using traditional methods has negative outcomes, such as fragmented client experiences, vulnerability to hacking, and lost payments. Blockchain technology, on the other hand, offers features such as enforcing rules with smart contract consensus, visibility and dispute prevention, payment loss prevention, and reversibility and control in case of scams. All these features play a crucial role in mitigating risks, which provides memorable customer experiences.

Table 5.12: Sub-theme 3.2: Customer Experience

Theme 3: Effects on Payment Services		
Sub-theme 3.2: Customer Experience		
P#	**Participant Insight**	**Literature Source**
P12	Smart contract consensus reducing risks	Unlike traditional contracts, smart contract consensus secured by blockchain technology offers reduced transaction risk, less administration, decreased service costs and enhanced effectiveness of business processes (Taherdoost, 2023).

Theme 3: Effects on Payment Services		
Sub-theme 3.2: Customer Experience		
P#	**Participant Insight**	**Literature Source**
P12	Visibility and dispute prevention	Mahmudnia *et al*. (2022) aver that blockchain innovations have improved the payment system in that a blockchain- based network can record every transaction made on a single digital gateway. Transaction disputes are reduced owing to the safe network.
P12	Payment loss prevention	Furthermore, Mahmudnia *et al*. (2022) confirm that the loss of payments are prevented as automatic payments are made using self-executing codes that prevent both the participant and the developer who has written the code to sway the agreement or defer the payment.
P13	Reversibility and control in case of scams	Chen *et al*. (2020:24) state that "the non-reversibility mechanisms of blockchain result in error intolerance". Furthermore, Hilary and Liu (2021) reiterate that centralised databases hold only one primary version of a database and a distributed database comprises of multiple nodes that work together under one umbrella. Should one of the nodes collapse (e.g., hardware glitch), the integrity of the database will not be compromised, thereby making it 'fault tolerant'.

P=Participant

5.2.3.3 Sub-theme 3.3: Transaction Transparency

The lack of transparency in traditional transaction processes can lead to errors, disputes and fraud, further undermining the efficiency and reliability of banking services (Sanyaolu *et al*., 2024:41). The transparency aspect of blockchain technology builds trust, which reduces the likelihood of fraud (Raghavendra & Lingam, 2024; Ajayi-Nifise *et al*., 2024). The findings revealed that blockchain technology in payment services provides transparency and immutability, and these features are an attraction to intermediaries to embrace the technology.

Table 5.13: Sub-theme 3.3: Transaction Transparency

Theme 3: Effects on Payment Services		
Sub-theme 3.3: Transaction Transparency		
P#	**Participant Insight**	**Literature Source**
P2, P7	Provides transparency and immutability	An immutable ledger is secured by blockchain applications that facilitate trustless transactions, resulting in reduced fraud and eliminating the need for intermediaries (Gupta, 2017). Flovik *et al*. (2021) conclude that blockchain aids organisations with maintaining an immutable record of transactions, ensuring that information is securely shared among relevant parties within a selected network. The immutable ledger ensures that once data is recorded on the blockchain, it cannot be altered or tampered with, which provides high data integrity and deters unauthorised changes. Intermediaries might pilot the technology as a business transformative opportunity in their operations to boost their strengths (Feulner *et al*., 2022).

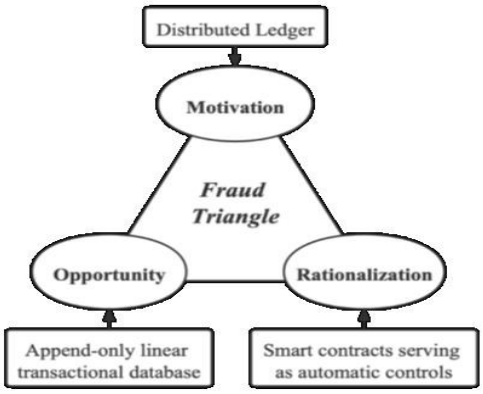
P=Participant

5.2.3.4 Sub-theme 3.4: Fraud Prevention

As technology evolves, fraudsters become more sophisticated in their tactics to commit fraud.

Fraud is not only prevalent in finance, it has an impact on people, industries and the environment. The findings revealed that it is impossible for fraud to be entirely eliminated. However, the features and real-time capabilities of blockchain technology in payment services can significantly reduce fraud. These features include real-time monitoring and traceability, digital identity and secure payments, as well as combining blockchain with fraud prevention tools.

Table 5.14: Sub-theme 3.4: Fraud Prevention

Theme 3: Effects on Payment Services		
Sub-theme 3.4: Fraud Prevention		
P#	**Participant Insight**	**Literature Source**
	Real-time monitoring and traceability	Rather than merely supporting a technological infrastructure, blockchain technology enables real-time triggering, execution, monitoring and control of transactions within the ecosystem that it provides (Şeyma Alkan, 2021). An immutable ledger is secured by blockchain applications that facilitate trustless transactions, resulting in reduced fraud and eliminating the need for intermediaries (Gupta, 2017).
	Digital identity and secure payments	Blockchain is an enabling technology for building digital identity, which can be maintained on a shared ledger enabling banks to access relevant parts of the stored data to perform due diligence checks. Digital identity for individuals improves security, speed of transactions and user experience (Devi *et al*., 2022).
	Combining BCT with fraud prevention tools	Chen (2022) depicts three elements that contribute to fraudulent activities as shown in figure 5.1. Adeyemo and Jacob (2024) explain that **motivation/pressure** highlight the financial or emotional pressure to commit fraud; **opportunity** refers to situations that give rise for fraud to occur, and **rationalisation** represents the mental reasoning people use to justify their fraudulent action. According to Louati *et al*. (2024), the implementation of blockchain technology together with machine learning, smart contracts, intrusion detection systems, multifactor authentication and strategic integration of advanced data analytics limits fraudulent behaviour. Adeyemo and Jacob (2024:141) furthermore explain that "**pressures** are alleviated through enhanced security measures, **opportunities** are curtailed through the deployment of sophisticated technological controls, and **rationalisations** are challenged by the accountability and traceability embedded in these innovations".  **Figure 5.1: How blockchain characteristics help to break the fraud triangle (Source: Chen, 2022)**

P=Participant

5.3 Conclusion

> "1991 - A cryptographically secured chain of blocks is described for the first time by Stuart Haber and W Scott Stornetta.
>
> 1998 - Computer scientist Nick Szabo works on 'bit gold', a decentralised digital currency.
>
> 2000 - Stefan Konst publishes his theory of cryptographic secured chains, plus ideas for implementation.
>
> 2008 - Developer(s) working under the pseudonym Satoshi Nakamoto release a white paper establishing the model for a blockchain.
>
> 2009 - Nakamoto implements the first blockchain as the public ledger for transactions made using bitcoin" (ICAEW, 2024:1).

It was only in 2017 that the Bank took an interest in blockchain technology and seriously engaged in experiments and use cases from 2018 onwards. The Bank has maintained consistent interest and is now live in production in certain areas in the business.

The twelve sub-themes have been discussed based on the RQs, revealing that the data obtained, supports literature and aligns with conclusions drawn from prior research findings and recommendations. Research question 1 (RQ1) aimed to reveal the challenges faced by the Bank in relation to blockchain technology in payment services. The answers to this question revealed that whilst some of the challenges are ongoing, others are in the process of being overcome. Feedback from the participants reinforces the challenges discussed in literature which encompasses people, processes, procedures and technology. The findings aligns with previous research studies. Research question 2 (RQ2), pursued to understand the benefits of blockchain technology, which were found to be beneficial to the Bank. The findings revealed that that the Bank will continue to adapt the technology to further increase the benefits that can be gained. In research question 3 (RQ3), the researcher sought to understand what effects blockchain technology has in the Bank's payment services. The findings revealed that whilst certain challenges such as operational efficiency requires improvement, the benefits outweigh the challenges. Payment services done via traditional banking methods has less value to both the Bank and its clients. Transitioning to blockchain technology is one of many innovations the Bank is currently working on to adopt a lens of functional understanding as they take a risk-conscious approach towards the technology.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This study aimed to identify and analyse the key challenges of implementing blockchain technology within the South African banking industry, with a particular focus on its application in payment services. It examined the potential benefits of blockchain technology for payment processes in the South African banking sector and evaluated the technology's impact on payment services at a selected South African Commercial Bank. The Bank's exploration of blockchain aligns with its broader digital strategy, showcasing its commitment to innovation and openness to adopting emerging technologies. Notably, there is alignment between the Bank's technology strategy and its strategic objectives, with a strong emphasis on blockchain as a pivotal driver of digital transformation.

The research revealed that the Bank employs several strategies to address the challenges associated with adopting blockchain in payment services, recognising the risks, complexities and security vulnerabilities involved. Despite these challenges, the Bank perceives blockchain as having significant potential to enhance the future of financial services. Findings suggest that the deployment of blockchain technology can bring substantial benefits, including increased efficiency and cost reduction in domestic, international and cross-currency payment services.

This chapter is structured as follows: section 6.1 provides an introduction and overview of the study's key objectives and findings; section 6.2 summarises the study's primary findings; section 6.3 outlines the study's limitations; section 6.4 offers recommendations for future research; and section 6.5 concludes the study.

6.2 Summary of the findings

Returning to the research questions established in Chapter One, this summary meets the research purpose.

Research Question 1: What are the key challenges of applying blockchain technology in the South African banking industry?

a) The Commercial Bank in particular, that was used for this study, plans to adopt a proactive approach to address these challenges by employing a number of strategies, such as improving regulatory reporting infrastructure, collaborating closely with regulators, engaging with regulators to build controls, conducting rigorous evaluations, identifying partners, participating in blockchain networks, expanding the

ecosystem, driving cultural change, embracing new technology, investing in experimentation, and promoting education and market intelligence.

b) The challenges span compliance, governance and regulation; acceptance of the technology; change management; technology evolvement; technology and innovation understanding; collaboration; and cost factors. Addressing these challenges will be crucial for the successful integration of blockchain technology into the payments services of all South African banks who may be considering to implement blockchain technology.

c) The challenge of strengthening data privacy in financial transactions within the strict legislative and banking governance environment of South Africa is a huge challenge. Blockchain technology can strengthen data privacy through cryptography, self-sovereign identity (SSI) and the utilisation of private networks.

d) Different business areas within the Bank currently operate independently, and there is a lack of a comprehensive architecture to enable blockchain economies to operate outside of silos. Whilst strategic decisions regarding interoperability have not yet been finalised, the Bank has developed a unique API layer to facilitate integration across various systems and channels, connecting different bank entities and branches. The concept of a single trusted area of transaction, driven by consensus mechanisms, eliminates the need for traditional protocols. The use of blockchain protocols that promote interoperability is considered a potential solution.

e) The Bank encounters the risks of non-adherence to compliance, governance and regulation by using blockchain technology to execute payment services. Additionally, the uncertainty of untested technology and the challenges of integrating it into existing systems can be costly and disruptive. Conversely, failing to adopt blockchain technology could result in the Bank becoming irrelevant in a world moving toward distributed ledger technologies.

f) The challenge of integrating legacy architecture and new business models to effect payment services using blockchain technology can seamlessly complement existing systems and processes with the use of API layers and automation. On the other hand, blockchain technology might not necessitate integration, as it can potentially replace or rebuild legacy systems to support new business models.

g) The assimilation of blockchain technology into the current technology stack is challenging as there is a need to integrate with existing technology, build independent infrastructure, and address legacy system limitations.

h) Using blockchain technology for payment services is digital in nature, therefore onboarding any analogue transactions would be met with significant challenges. This implies that historical data may not be directly migrated but rather re-entered or re-

recorded in the new system, which is costly. Since the Bank is required to hold information for a specific duration (five years) to comply with regulation, it is suggested that when transitioning to blockchain technology, the existing databases and information in the legacy construct be maintained for compliance purposes during this period.

i) Blockchain technology is associated with consuming high amounts of energy. The Bank recognises of the environmental impact, particularly in cryptocurrency. For this reason, the Bank is actively involved in environmental projects and avoids energy-intensive activities like mining. Blockchain adoption is seen as a way to reduce the carbon footprint by replacing legacy systems and potentially contributing to a greener technology stack. The Bank is exploring carbon-neutral ecosystems and technologies to minimise environmental damage.

j) The management of blockchain technology requires technical expertise. The Bank faces a shortage of in-house experts in the field of blockchain. It is foreseen that with the implementation of blockchain technology within the payment services space, the head count of banking staff could increase or decrease. The overall staff compliment within the Bank requires upskilling in their respective division.

k) Transitioning to blockchain technology to execute payment services in the Bank is a huge change that poses challenges such as capital constraints, the need for resources to replace outdated technologies, shortage of qualified staff, integrating with legacy systems, breaking down internal silos, uncertainty in the regulatory environment, lack of strategic leadership planning, resistance to change, and misconceptions about the technology.

Research Question 2: What are the main benefits of blockchain for payment services in the South African banking sector?

a) Payment services using blockchain technology is complex as regulatory and compliance frameworks are still unclear, and the development of laws and regulations are still in the making. Existing legacy architecture is a huge constraint in the banking environment as the integration of old systems with new technology poses compatibility issues. The nature of distributed ledger is to permanently store information, which will induce scalability issues due to a high volume of transactional data. Apart for the scalability issue, integrating blockchain into other banking services requires the interaction of different networks, which could negatively influence the decision-making process, resulting in infrastructure strain. The lack of understanding the potential that the technology offers requires well-structured blockchain educational programmes.

b) Fragmented client experience, vulnerability to hacking, and funds being lost are risks experienced using the traditional framework. Using blockchain technology to execute payment services appears to have less risks, as payments can be done using hot or cold wallets. Additionally, smart contract consensus secured by blockchain technology offers reduced transaction risk, and loss of payments are prevented as automatic payments are made using self-executing codes.

c) Time delay in cross-border and cross-currency payments are still challenging using traditional architecture. However, using blockchain technology can contribute to making payment services more seamless and transparent using automated processes which provide immediate verification, validation and real-time settlement.

d) An imperfect world will always be susceptible to human error. Automation features and consensus mechanisms inherent to blockchain ensure that multiple participants in the blockchain network validate and agree on the accuracy of transactions, reducing the likelihood of incorrect entries or discrepancies.

e) Blockchain technology has the potential to enhance security and deter fraud. Whilst fraud cannot be entirely eliminated, it can be significantly reduced through blockchain's features and real-time capabilities such as transparency and immutable ledger, real-time monitoring and traceability, digital identity and secure payments, and combining blockchain with fraud prevention tools.

f) Blockchain technology has the potential to disrupt the role of intermediaries in traditional banking. Intermediaries may be eliminated unless they adapt to incorporating blockchain technology into their services. Since blockchain technology is based on distributed trust, its effectiveness as an intermediary-free platform can benefit the banking and finance sector in terms of managing payment services at reduced transactions cost and reduced time delays.

g) The research findings revealed that the majority of participants do not believe it is necessary for SARS (South African Revenue Service) to be blockchain-enabled for the Bank to implement blockchain technology for monthly payments. The participants viewed blockchain as a tool that the Bank can use independently to optimise its payment processes. However, one participant suggested a conditional integration approach based on SARS' intended use of the blockchain system.

h) There is a symbiotic relationship between the ability of digital payment platforms and cybersecurity. Although blockchain technology in payment services is on the uprise given its distinctive characteristics, existing literature discusses apprehensions regarding the high risk of external cybersecurity threats in adopting this technology. Big corporate companies are concentrating more on when they will

experience a cyberattack rather than if there will be an attack as blockchain technology is susceptible to multiple cybersecurity attacks.

i) A system-wide blockchain collapse or fail is highly unlikely, as blockchain's distributed ledger mitigates the risk of single point of failure and the risk of data loss or system failure as it allows for identical data replication across multiple nodes over different locations. Should some nodes become compromised or unavailable, data will at all times be accessible from other nodes in the network.

Large financial institutions worldwide continue to invest in blockchain technology and enhance their workforce capabilities to fully leverage its benefits, while also developing protective strategies to address potential risks. Despite the challenges it presents, blockchain technology continues to grow and expand across various industries, with users remaining undeterred by the ongoing exploration of its possibilities.

Research Question 3: How does blockchain technology impact on payment services at a South African Commercial Bank?

a) This study highlighted that blockchain technology could add more value to enhance income generation in payment services diversification and the introduction of new revenue streams, lower-priced transactions, infrastructure savings, improved customer relationships, streamlined processes, and reduced operational costs.
b) The study revealed that by implementing blockchain technology protocols, it could reduce processing times, thereby reducing bank-related costs associated with peer- to-peer payments.
c) Smart contracts and cloud-based solutions hosted on a blockchain network collectively contributes to cost reduction for the Bank when effecting international and cross-currency payments.
d) The study revealed that blockchain technology can reduce costs for banks in terms of keeping records of transactions, eliminating the need for manual and time-consuming processes through technologies like Hyperledger.
e) The study also revealed that blockchain technology has the potential to influence the Bank's competitive positioning in the industry, ranging from cost savings to improved customer experiences and collaborative innovation.
f) The study furthermore revealed that blockchain technology could be a value-add for both the Bank and its client-base by improving operational efficiency, expanding business horizons, fostering collaboration, and offering cost-effective solutions for the organisation and its clients.

6.3 Limitations of the study

This study focused on drawing insights from subject matter experts in a selected South African Commercial Bank to understand the impact of blockchain technology on the banking sector. A total of 16 participants were interviewed for this study. These interviewees were selected based on their job description, which focused on the tactical and operational levels. No discussions were held at the strategic level, limiting the insights that could have been gained from a larger number of participants. Moreover, the sample population comprised a single case study. A study across multiple banks could potentially have provided richer data insights. The unit of observation did not include the broader financial sector that banks ordinarily engage with, such as non-banking financial institutions and regulators. This study applied an interpretive qualitative research design, aided thematic analysis, which can be influenced by opinion, and which could lend itself to a high level of subjectivity and bias.

6.4 Recommendations for future research

Based on the findings of this study, several recommendations are proposed to help South African banks, particularly the Commercial Bank studied, to navigate the challenges and maximise the benefits of adopting blockchain technology in payment services.

6.4.1 Strengthen compliance and regulatory collaboration

To address regulatory and governance challenges, it is recommended that the Bank deepen its collaboration with regulatory authorities. This should involve proactive engagement with policymakers to shape blockchain regulations that align with banking needs, potentially through industry coalitions (Acosta Llano *et al*., 2024). Establishing a structured set of compliance guidelines specifically for blockchain will benefit the Bank in refining their processes to improve risk management and to produce high quality regulatory reports that meet sector standards.

6.4.2 Bolster data privacy and security measures

Blockchain technology uses features such as secure private networks, self-sovereign identity (SSI) and encryption to protect sensitive data (Ahmed *et al*., 2022). These security-focused features could be beneficial to the Bank to align to the South African Constitution that enshrines data privacy through POPIA. Furthermore, to strengthen the security of blockchain payment services, it is crucial that the Bank builds fortified cybersecurity architecture to counteract external threats.

6.4.3 Promote environmental sustainability in blockchain initiatives

With the global focus on green initiatives, the energy-intensive nature of blockchain, related to cryptocurrency mining, remains to be a major concern. Banks are therefore recommended

to explore eco-friendly consensus processes and implement solutions to attain carbon neutrality, ensuring that blockchain implementation aligns with its environmental sustainability goals (Alzoubi & Mishra, 2023).

6.4.4 Invest in blockchain talent and upskilling

The limited pool of skilled blockchain specialists within the Bank, calls for investing in the hiring of external talent and upskilling internal employees to achieve blockchain proficiency. A deeper understanding across departments can be incorporated through continuous blockchain-focused education and training to ensure smooth implementation (Negi, 2024).

6.4.5 Prepare legacy systems for integration and transition

A thorough assessment is recommended as to whether the Bank should re-model the architecture, merge blockchain solutions with existing systems or apply a phased approach to either complement or replace outdated systems through a gradual roll-out. The latter approach could potentially minimise operational downtime and unnecessary expenses. As compliance to regulatory data retention requirements remain constant, the Bank should retain their legacy databases during the transition phase (Kolehmainen *et al*., 2020).

6.4.6 Prioritise smart contracts and cost-effective solutions

The use of smart contracts has multiple uses that the Bank could benefit from. Human involvement could become automated, reducing errors and improving transparency. Smart contracts together with cloud-based blockchain technologies not only simplifies currency exchanges but also improves the follow of cross-border payments to save time and cut costs (Drakopoulos *et al*., 2024).

6.4.7 Advance cybersecurity and fraud prevention measures

The Bank can benefit from blockchain's built-in security capabilities, such as tamper-proof real-time alerts, with further support of threat detection systems. By adopting this two-fold approach, cyber threats exclusive to blockchain-based payments can be controlled (Nimmagadda, 2021)..

6.5 Summary

The adoption of blockchain technology across various sectors confirms its value. Whilst it may not be the solution for all technology problems, its global acknowledgement highlights its potential. The Bank sees this potential and is pursuing it through a multi-layered adoption strategy. The alignment between their strategic and technology goals, advertises a futuristic Bank.

In this chapter, a thorough review of the challenges, impacts and benefits of adopting blockchain technology in payment services at a South African Commercial Bank have been presented, providing insight to the research questions. The research identified critical challenges related to clean energy options, merging technologies, data privacy, regulatory compliance and a limited supply of workforce specialists. However, amidst these challenges, the study also demonstrated that blockchain can streamline payments to be more efficient, cost-effective and secure.

The promising benefits of blockchain can reduce expenses through smart contracts and blockchain-based networks, providing smoother operations and saving time. While blockchain introduces promising advancements in fraud prevention, transparency and data privacy, it also signals potential risks in regard to interoperability with traditional banking systems and cybersecurity.

The limitations of this study were also acknowledged, noting that the reliance on a single banking institution, with more focus on tactical and operational perspectives and less of the strategic level, may have limited generalisability across the wider banking sector and the findings of this study. The interpretive qualitative research design, while effective for exploring in-depth insights, also introduced some subjectivity – a limitation common to this approach.

Finally, the research proposed actionable recommendations, underscoring the need for Banks to formulate and apply strong institutional policies and process flows, invest in the hiring of external talent and upskilling internal employees to achieve blockchain proficiency, build strong partnerships to boost data privacy and focus on developing solutions to integrate systems. By addressing these action points, South African banks can unlock the value of blockchain technology while managing connected risks. The recommendations offer a strategic roadmap to support the gradual and sustainable adoption of blockchain, positioning the Bank to leverage its benefits for improved efficiency and competitiveness in a rapidly evolving digital payment landscape.

REFERENCES

Acharya, A.S., Prakash, A., Saxena, P. & Nigam, A. 2013. Sampling: Why and how of it? *Indian Journal of Medical Specialities*, 4(2):330-333. doi.org/10.7713/ijms.2013.0032

Acharya, V.V., Cooley, T.F., Richardson, M.P. & Walter, I. 2011. *Market failures and regulatory failures: Lessons from past and present financial crises*. ADBI Working Paper No. 264. doi.org/10.2139/ssrn.1757711

Acosta Llano, E., Hurmelinna-Laukkanen, P. & Haapanen, L. 2024. Blockchain for the circular economy, implications for public governance. *International Journal of Public Sector Management*, 1-23. doi.org/10.1108/IJPSM-12-2023-0365

Adelekan, O.A., Adisa, O., Ilugbusi, B.S., Obi, O.C., Awonuga, K.F., Asuzu, O.F. & Ndubuisi. N.L. 2024. Evolving tax compliance in the digital era: A comparative analysis of AI-driven models and blockchain technology in U.S. tax administration. *Computer Science & IT Research Journal*, 5(2):311-335. doi.org/10.51594/csitrj.v5i2.759

Adelman, C., Jenkins, D. & Kemmis, S. 1976. Re-thinking case study: Notes from the second Cambridge conference. *Cambridge Journal of Education*, 6(3):139-150. doi.org/10.1080/0305764760060306

Adeyemo, K. & Jacob, F. 2024. A survey on the role of technological innovation in Nigerian deposit money bank fraud prevention. *South Asian Journal of Social Studies and Economics*, 21(3):133150. doi.org/10.9734/SAJSSE/2024/v21i3790

Agrawal, R. 2019. *The emergence of blockchain consortia.* [Online]. Available at: https://www.linkedin.com/pulse/emergence-blockchain-consortia-ravikant-agrawal. [Accessed: 5 February 2020].

Ahmed, M., Islam, A., Shatabda, S. & Islam, S. 2022. Blockchain-based identity management system and self-sovereign identity ecosystem: A comprehensive survey. *IEEE Access*, 10:113436-113481. doi.org/10.1109/ACCESS.2022.3216643

Aikenhead, G. 1997. A framework for reflecting on assessment and evaluation. In *Globalisation of Science Education: International Conference on Science Education,* Seoul, Korea, 26-30 May, 195-199.

Ajayi-Nifise, A., Falaiye, T., Olubusola, O., Daraojimba, A. & Mhlongo, N. 2024. Blockchain in U.S. accounting: A review: Assessing its transformative potential for enhancing transparency and integrity. *Finance & Accounting Research Journal*, 6(2):159182. doi.org/10.51594/farj.v6i2.786

Akaranga, S. & Makau, B. 2016. Ethical considerations and their applications to research: A case of the University of Nairobi. *Journal of Educational Policy and Entrepreneurial Research*, 3(12):1-9.

Alabi, K., 2017. Digital blockchain networks appear to be following Metcalfe's Law. *Electronic Commerce Research and Applications*, 24:23-29. doi.org/10.1016/j.elerap.2017.06.003

Alam, M.A. & Jain, S. 2020. Blockchain implementation using smart grid-based smart city. In S. Krishnan, V.E. Balas, E.G. Julie, Y.H. Robinson, S. Balaji & R. Kuma (eds.), *Handbook of research on blockchain technology*. Academic Press, 133-169.

Alexander, D. 2019. *Central banks use blockchain for first time to swap currency.* [Online]. Available at: https://www.forbes.com/sites/rogerhuang/2019/06/23/central-banks-are-using-blockchain-to-stabilize-the-global-financial-system/?sh=5484cdb459d5 [Accessed: 14 April 2021].

Ali, A., Khan, A., Ahmed, M. & Jeon, G. 2022. BCALS: Blockchain-based secure log management system for cloud computing. *Transactions on Emerging Telecommunications Technologies*, 33(4):1-21. doi.org/10.1002/ett.4272

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(C):1-19. doi.org/10.1016/j.ijinfomgt.2020.102199

Alkan, B.S. 2021. Real-time blockchain accounting system as a new paradigm. *The Journal of Accounting and Finance,* 41-58.

Alla, S., Soltanisehat, L., Tatar, U. & Keskin, O. 2018. Blockchain technology in electronic healthcare systems. *IISE Annual Conference and Expo 2018*, Old Dominion University Norfolk, VA 23529, USA, May 2018.

Allen, F. & Gale, D. 2007. *Understanding financial crises.* Oxford: Oxford University Press.

Almalki, S. 2016. Integrating quantitative and qualitative data in mixed methods research—challenges and benefits. *Journal of Education and Learning*, 5(3):288. doi.org/10.5539/jel.v5n3p288

Alshinwan, M., Shdefat, A.Y., Mostafa, N., Alsokkar, A.A.M., Alsarhan, T. & Almajali, D. 2023. Integrated cloud computing and blockchain systems: A review. *International Journal of Data and Network Science*, 7(2):941-956. doi.org/10.5267/j.ijdns.2022.12.016

Alvi, M. 2016. *A manual for selecting sampling techniques in research*. MPRA Paper No. 70218, 1-56. https://mpra.ub.uni-muenchen.de/id/eprint/70218

Alzoubi, Y.I. & Mishra, A. 2023. Green blockchain – A move towards sustainability. *Journal of Cleaner Production*, 430:139541-139554. doi.org/10.1016/j.jclepro.2023.139541

Amini, M. & Javid, N.J. 2023. Organisation and environment (TOE) framework toward supply chain management system based on cloud computing technology for small and medium enterprises. *International Journal of Information Technology and Innovation Adoption*, 11(8):1-19.

Anghelache, C., Barbu, C. & Anghel, M. 2020. Blockchain in the Big Data era. *Proceedings of the 25th International Scientific Conference of PGV Network 2019*, 12-13 September, 73-84.

Argarwal, R., Sambamurthy, V. & Stair, R.M. 2000. The evolving relationship between general and specific computer self-efficacy. *Journal of Allergy and Clinical Immunology*, 11(4):418-430. doi.org/10.1016/j.jaci.2012.05.050

Arora, N. 2022. *Theories of blockchain: Its evolution and application for security, privacy and trust management.* In P. Kumar, A. Tomar & R. Sharmila, (eds.), *Emerging technologies in computing.* CRC Press.

Arrow, K.J. 1964. The role of securities in the optimal allocation of risk-bearing. *Review of Economic Studies*, 31(2):91-96. doi.org/10.2307/2296188

Arthur, S. & Nazroo, J. 2003. *Designing fieldwork strategies and materials.* In J. Ritchie & J. Lewis (eds.), *Qualitative research practice a guide for social science students and researcher*. Sage, 110-133.

Asuquo, P., Ogah, C., Hathal, W. & Bao, S. 2021. *Blockchain meets cybersecurity: Security, privacy, challenges, and opportunity.* In S. Kim & G. Deka (eds.), *Advanced applications of blockchain technology.* Springer, 115-140.

Atca Gorgun, O. & Wolfs, B. 2021. Impact of the new digital competitors on Swiss banking business models. *International Journal of Research in Business and Social Science*, 10(2):33-45.

Atlam, H.F., Alenezi, A., Alassafi, M.O. & Wills, G.B. 2018. Blockchain with Internet of Things: Benefits, challenges, and future directions. *International Journal of Intelligent Systems and Applications*, 10(6):40-48. doi.org/10.5815/ijisa.2018.06.05

Auerbach, C. & Silverstein, L.B. 2003. *Qualitative data: An introduction to coding and analysis*. New York: University.

Aust, B., Rugulies, R., Finken, A. & Jensen, C. 2010. When workplace interventions lead to negative effects: Learning from failures. *Scandinavian Journal of Public Health*, 38(Suppl. 3):106-119.

AZ Quotes. 2024. *John C. Maxwell quotes about growth.* https://www.azquotes.com/author/9639-John_C_Maxwell/tag/growth [Accessed: 25 October 2024].

Babbie, E. 2008. *The basics of social research*. 4th ed. California: Thomas Wadsworth.

Bagozzi, R.P. 2007. The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the Association for Information Systems*, 8(4):244-254.

Bagozzi, R.P., Davis, F.D.D. & Warshaw, P.R. 1992. Development and test of a theory of technological learning and usage. *Human Relations*, 45(7):659-686.

Baker, J. 2012. T*he technology–Organisation–Environment framework*. In Y.K. Dwivedi, M.R. Wade & S.L. Schneberger (eds.), *Information systems theory explaining and predicting our digital society, vol 1*. Springer, 231-243.

Barglowski, K. 2018. *Where, what and whom to study? Principles, guidelines and empirical examples of case selection and sampling in migration research.* Dortmund: Technical University, 151-168.

Baxter, P. & Jack, S. 2008. Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, 13(4):544-559.

Bayram, O. 2020. Importance of blockchain use in cross-border payments and evaluation of the progress in this area. *Doğuş Üniversitesi Dergisi*, 21(1):171-189.

Beachy, B. 2012. *A financial crisis manual: Causes, consequences, and lessons of the financial crisis*. Medford: Tufts.

Bech, M. & Hancock, J. 2020. Innovations in payments. *BIS Quarterly Reviews*, 7(March): 21-36.

Bech, M.L., Gambacorta, L. & Kharroubi, E. 2014. Monetary policy in a downturn: Are financial crises special? *International Finance*, 17(1):99-119. doi.org/0.1111/infi.12040

Bedin, A.R.C., Capretz, M. & Mir, S. 2021. Blockchain for collaborative businesses. *Mobile Networks and Applications*, 26(1):277-284. doi.org/10.1007/s11036-020-01649-6

Behfar, K. & Okhuysen, G.A. 2018. Discovery within validation logic: Deliberately surfacing, complementing, and substituting abductive reasoning in hypothetico-deductive inquiry. *Organisation Science*, 29(2):323-340. doi.org/10.1287/orsc.2017.1193

Bennet, D., Maria, L., Putri Ayu Sanjaya, Y. & Rahmania Az Zahra, A. 2024. Blockchain technology: Revolutionising transactions in the digital age. *ADI Journal on Recent Innovation (AJRI)*, 5(2):194-199. doi.org/10.34306/ajri.v5i2.1065

Biddle, C. & Schafft, K.A. 2015. Axiology and anomaly in the practice of mixed methods work: Pragmatism, Valuation, and the transformative paradigm. *Journal of Mixed Methods Research*, 9(4):320-334. doi.org/10.1177/1558689814533157

Bokolo, A.J. 2022. Exploring interoperability of distributed ledger and decentralised technology adoption in virtual enterprises. *Information Systems and e-Business Management*, 20(4):685-718. doi.org/10.1007/s10257-022-00561-8

Bokolo, A. Jnr. 2024. Enhancing blockchain interoperability and intraoperability capabilities in collaborative enterprise-a standardised architecture perspective. *Enterprise Information Systems*, 18(3):297-337. doi.org/10.1080/17517575.2023.2296647

Boru, T. 2018. Chapter five research design and methodology 5.1. In *The impact of industry concentration on performance, exploring a comprehensive bank performance model: the case of the Ethiopian banking sector.* PhD thesis, University of South Africa. doi.org/10.13140/RG.2.2.21467.62242

Bott, J. & Milkau, U. 2016. Towards a framework for the evaluation and design of distributed ledger technologies in banking and payments. *Journal of Payments Strategy & Systems*, 10(2):153-171.

Böttcher, T.P., Empelmann, S., Weking, J., Hein, A. & Krcmar, H. 2024. Digital sustainable business models: Using digital technology to integrate ecological sustainability into the core of business models. *Information Systems Journal*, 34(3):736-761. doi.org/10.1111/isj.12436

Boyne, G.A., Gould-Williams, J.S., Law, J. & Walker, R.M. 2005. Explaining the adoption of innovation: An empirical analysis of public management reform. *Environment and Planning C: Government and Policy*, 23(3):419-435. doi.org/10.1068/c40m

Braun, V. & Clarke, V. 2022. *Thematic analysis: A practical guide*. A. Maher (ed.). London: Sage.

Braun, V. & Clarke, V. 2024. Supporting best practice in reflexive thematic analysis reporting in palliative medicine: A review of published research and introduction to the Reflexive Thematic Analysis Reporting Guidelines (RTARG). *Palliative Medicine*, 38(6):608-616. doi.org/10.1177/02692163241234800

Brijmohun, A. 2017. *An analysis of the outlook for blockchain technology in the South African banking industry*. Master's thesis, University of Witwatersrand, South Africa.

Buitenhek, M. 2016. Understanding and applying blockchain technology in banking: Evolution or revolution? *Journal of Digital Banking*, 1(2):111-119.

Cai, C.W. 2018. Disruption of financial intermediation by FinTech: A review on crowdfunding and blockchain. *Accounting and Finance*, 58(4):965-992. doi.org/10.1111/acfi.12405

Candy, P.C. 1989. Constructivism and the study of self-direction in adult learning. *Studies in the Education of Adults*, 21(2): 95-116. doi.org/10.1080/02660830.1989.11730524

Cangemi, M.P. & Brennan, G. 2019. Blockchain auditing – Accelerating the need for automated audits! *Economics, Finance, Business & Industry Journals*, 59(4):1-11. https://doi.org/10.1080/07366981.2019.1615176

Carr, W. & Kemmis, S. 1986. *Becoming critical: Education, knowledge, and action research*. Deakin University Press.

Casey, M.J. & Vigna, P. 2019. *The truth machine*. New York: St Martin's Press.

Chalmers, D., Manley, D. & Wasserman, R. 2009. *Metametaphysic: New essays on the foundations of ontology*. New York: Oxford.

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*, 158:1-39. doi.org/10.1016/j.techfore.2020.120166

Chapiro, C. 2021. *Working toward financial inclusion with blockchain*. [Online]. Available: https://shttps//ssir.org/articles/entry/working_toward_financial_inclusion_with_blockchain#sir.org/articles/entry/working_toward_financial_inclusion_with_blockchain%23 [Accessed: 16 February 2022].

Chen, S., Liu, X., Yan, J., Hu, G. & Shi, Y. 2020. Processes, benefits, and challenges for adoption of blockchain technologies in food supply chains: A thematic analysis. *Information Systems and e-Business Management*, 19(3):909-935. doi.org/10.1007/s10257-020-00467-3

Chen, T. 2022. Blockchain and accounting fraud prevention: A case study on Luckin coffee. In *Proceedings of the 2022 7th International Conference on Social Sciences and Economic Development (ICSSED 2022)*, 44-49.

Chiu, C.-Y., Chen, S. & Chen, C.-L. 2017. An integrated perspective of TOE framework and innovation diffusion in broadband mobile applications adoption by enterprises. *Economics and Social Sciences (IJMESS)*, 6(1):14-39.

Choithani, T., Chowdhury, A., Patel, S., Patel, P., Patel, D. & Shah, M. 2024. A comprehensive study of artificial intelligence and cybersecurity on bitcoin, crypto currency and banking system. *Annals of Data Science*, 11(1):103-135. doi.org/10.1007/s40745-022-00433-5

Chong, H. & Diamantopoulos, A. 2020. Integrating advanced technologies to uphold security of payment: Data flow diagram. *Automation in Construction*, 11:1-14. doi.org/10.1016/j.autcon.2020.103158

Chowdhury, M., Suchana, K., Alam, S. & Khan, M. 2021. Blockchain application in banking system. *Journal of Software Engineering and Applications*, 14(07):298-311. doi.org/10.4236/jsea.2021.147018

Ciccaglione, B. 2019. *Utilising blockchain trade finance to promote financial inclusion.* Honors Scholar Theses, 619. https://opencommons.uconn.edu/srhonors_theses/619 [Accessed: 15 June 2024].

Clohessy, T., Acton, T. & Rogers, N. 2019. *Blockchain adoption technological organisational and environmental.* In H. Treiblmaier & R. Beck (eds.), *Business transformation through blockchain: Volume II*. Palgrave MacMillan, 46-77.

Cohen, L., Manion, L. & Morrison, K. 2018. *Case studies*. In L. Cohen, L. Manion & K. Morrison (eds.), *Research methods in education*. Routledge, 253-263.

Cole, J., Godwin, A., Melo, J.M. & Rohde, J.A. 2020. Work-in-progress: A Delphi study of skills and competencies for the hydrocarbon industry. *ASEE'S Virtual Conference: At Home with Engineering Education,* 22-26 June, Paper ID #30113. https://par.nsf.gov/servlets/purl/10217756

Conti, M., Sandeep, K.E., Lal, C. & Ruj, S. 2018. A survey on security and privacy issues of bitcoin. *IEEE Communications Surveys and Tutorials*, 20(4):3416-3452.

Cope, M. 2010. *Coding transcripts and diaries.* In N. Clifford, D. French & G. Valentine (eds.), *Key methods in geography.* Singapore: Sage, 886-910.

Creswell, J.W. 2002. *Research design: Qualitative, quantitative and mixed methods approaches*. 2nd ed. California: Sage.

Creswell, J.W. 2007. *Qualitative inquiry & research design: Choosing among five approaches*. 2nd ed. California: Sage.

Creswell, J.W. 2009. *Research design: Qualitative, quantitative, and mixed methods approaches.* 3rd ed. California: Sage.

Creswell, J.W. & Clark, V.L.P. 2018. *Designing and conducting mixed methods research*. 3rd ed. California: Sage.

Creswell, J.W. & Creswell, J.D. 2018. *Research design: Qualitative, quantitative and mixed methods approaches*. 5th ed. California: Sage.

Creswell, J.W., Fetters, M. & Ivankova, N. 2004. Designing a mixed method study in primary care. *Annals of Family Medicine*, 2(1):1-6. doi.org/10.1136/bmj.325.7354.22

Crosby, M., Pattanayak, P., Verma, S. & Kalyanaraman, V. 2016. *Applied Innovation Review*, 2:1-16.

Crotty, M. 1988. *The foundations of social research: Meaning and perspective in the research process.* London: Sage.

Csapó, B. 1997. The development of inductive reasoning: Cross-sectional assessments in an educational context. *International Journal of Behavioural Development*, 20(4):609-626.

Cunningham, J.W. & Fitzgerald, J. 1996. Epistemology and reading. *Reading Research Quarterly*, 31(1):36-60. doi.org/10.1598/rrq.31.1.3

Curry, M. 2018. *Blockchain for KYC: Game-changing RegTech innovation.* [Online]. Available at:https://www.ibm.com/blogs/blockchain/2018/09/blockchain-for-kyc-game-changing-regtech-innovation/. [Accessed: 17 May 2021].

Dai, J. & Vasarhelyi, M.A. 2017. Toward blockchain-based accounting and assurance. *Journal of Information Systems*, 31(3):5-21. doi.org/10.2308/isys-51804

Dale, O. 2019. *Benefits of blockchain technology for the financial services industry*. [Online]. Available at: https://blockonomi.com/blockchain-financial-industry/ [Accessed: 28 October 2024].

Daluwathumullagamage, D.J. & Sims, A. 2021. Fantastic beasts: Blockchain based banking. *Journal of Risk and Financial Management*, 14(4):170. doi.org/10.3390/jrfm14040170

D'Amato, C., Fanizzi, N. & Esposito, F., 2008. Query Answering and ontology population: An inductive approach. In S. Bechhofer, M. Hauswirth, J. Hoffmann, M. Koubarakis (eds.), *The semantic web: Research and applications*. ESWC 2008. Lecture Notes in Computer Science, vol. 5021. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-68234-9_23

Daychopan, D. 2016. *Barter to bitcoin – History of money and the Blockchain.* [Online]. Available at: https://www.linkedin.com/pulse/barter-bitcoin-history-money-blobkchain-danial-daychopan [Accessed: 3 January 2022].

De Oliveira Martins, M.D.R.F. & De Oliveira, T.A.G.F. 2010. Information technology adoption models at firm level: Review of literature. *Proceedings of the 4th European Conference on Information Management and Evaluation (ECIME 2010)*, Lisbon, Portugal, 9-10 September, 312-322.

De Filippi, P., Mannan, M. & Reijers, W. 2020. Blockchain as a confidence machine: The problem of trust & challenges of governance. *Technology in Society*, 62:1-6. doi.org/10.1016/j.techsoc.2020.101284

De Filippi, P., Mannan, M. & Reijers, W. 2022. The alegality of blockchain technology. *Policy and Society*, 41(3):358-372. doi.org/10.1093/polsoc/puac006

De Gregori, T. 1967. Tribal and peasant economies: Readings in economic anthropology. *Journal of Economic Issues*, 1(4):362-365. doi.org/10.1080/00213624.1967.11502798

Deloitte. 2017. *Blockchain in banking while the interest is huge, challenges remain for large scale adoption.* [Online]. Available at: https://www2.deloitte.com/content/dam/Deloitte/in/Documents/strategy/in-strategy-innovation-blockchain-in-banking-noexp.pdf [Accessed: 28 October 2024].

De Meijer, C.R.W. 2020. *Remaining challenges of blockchain adoption and possible solutions.* [Online]. Available at: https://www.finextra.com/blogposting/18496/remaining-challenges-of-blockchain-adoption-and-possible-solutions [Accessed: 26 September 2020].

Demuyakor, J. 2020. Ghana go digital agenda: The impact of zipline drone technology on digital emergency health delivery in Ghana. *Shanlax International Journal of Arts, Science and Humanities*, 8(1):242-253. doi.org/10.34293/ sijash.v8i1.3301

DePoy, E. & Gitlin, L.N. 2015. *Introduction to research: Understanding and applying multiple strategies*. 5th ed. Missouri: Book Aid.

Devi, S., Kotian, S., Kumavat, M. & Patel, D. 2022. Digital identity management system using blockchain. *SSRN Electronic Journal*, 1-6. doi.org/10.2139/ssrn.4127356

Dey, I. 2003. *Qualitative data analysis: A user-friendly guide for social scientists*. London: Routledge.

Dierksmeier, C. & Seele, P. 2020. Blockchain and business ethics. *Business Ethics, the Environment & Responsibility* 29(2):348–359. doi.org/10.1111/beer.12259

Dionysopoulos, L. & Giaglis, G. 2022. *Towards optimal technological solutions for central bank digital currencies.* In J. Soldatos & D. Kyriazis (eds.), *Big Data and artificial intelligence in digital finance: Increasing personalisation and trust in digital finance using Big Data and AI.* Springer, 91-14.

Di Orio, G., Brito, G. & Maló, P. 2022. S*emantic interoperability framework for digital finance applications.* In Soldatos, J. & Kyriazis, D. (eds.), *Big data and artificial intelligence in digital finance: Increasing personalisation and trust in digital finance using big data and AI.* Springer, 67–90.

Dorsala, M.R., Sastry, V.N. & Chapram, S. 2021. Blockchain-based solutions for cloud computing: A survey. *Journal of Network and Computer Applications*, 196(C). doi.org/10.1016/j.jnca.2021

Drakopoulos, D., Vasilyev, M.D. & Villafuerte, M. 2024. *Cross-border payments integration in Latin America and the Caribbean.* IMF Working Paper Western Hemisphere Department, WP/24/119, 1-27. https://www.imf.org/-/media/Files/Publications/WP/2024/English/wpiea2024119-print-pdf.ashx

Dubey, R., Gunasekaran, A., Bryde, D.J., Dwivedi, Y.K. & Papadopoulos, T. 2020. Kent academic repository. *International Journal of Production Research*, 58(11):197-206. doi.org/10.1080/00207543.2020.1722860

Earle, T.C. 2009. Trust, confidence, and the 2008 global financial crisis. *Risk Analysis*, 29(6):785-792. doi.org/10.1111/j.1539-6924.2009.01230.x

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

Egwutuoha, I.P., Levy, D., Selic, B. & Chen, S. 2013. A survey of fault tolerance mechanisms and checkpoint/restart implementations for high performance computing systems. *Journal of Supercomputing*, 65(3):1302-1326. doi.org/10.1007/s11227-013-0884-0

Elkjaer, B. & Simpson, B. 2011. Pragmatism: A lived and living philosophy. What can it offer to contemporary organisation theory? *Research in the Sociology of Organisations*, 32: 55-84. doi.org/10.1108/S0733-558X(2011)0000032005

Esteva, P.R., Torres-Padrosa, V., El-Fakdi, A., Gibovic, D., Hornyak, O., Maicher, L. & Miralles, F. 2017. A survey of blockchain technologies for open innovation. *Conference: World Open Innovation Conference 2017,* San Francisco, CA,13-15 December.

Etikan, I. & Bala, K. 2017. Sampling and sampling methods. *Biometrics and Biostatistics International Journal,* 5(6):215-217.

Eyal, I. 2017. Blockchain technology: Transforming libertarian cryptocurrency dreams to finance and banking realities. *Institute of Electrical and Electronics Engineers*, 50(9):38-49. doi.org/10.1109/MC.2017.3571042

Faizan, R. & Zehra, N. 2016. Quality work-life as predictor to organisational commitment under contrasting leadership styles: I.T. responses from Pakistan's private software houses. *Global Journal of Management And Business Research*, 16(6):1-17.

Faria, I. 2021. The market, the regulator, and the government: Making a blockchain ecosystem in the Netherlands. *Finance and Society*, 7(1):40-56. doi.org/10.2218/finsoc.v7i1.5590

Fatoki, O.I. & Wanjagi, J. 2019. The future of Kenyan banks: Mitigate financial risk using cryptocurrencies and blockchain technology. *RAIS Journal for Social Sciences*, 3(2):69-84. doi.org/10.5281/zenodo.3549497

Feulner, S., Guggenberger, T., Stoetzer, J.-C. & Urbach, N. 2022. Shedding light on the blockchain disintermediation mystery: A review and future research agenda. *Proceedings of the Thirtieth European Conference on Information Systems (ECIS 2022),* Timisoara, Romania, 1-21.

FinExtra. 2019. *Blockchain and disruption in the financial world: Will banks survive?* [Online]. Available at: https://www.finextra.com/blogposting/16658/blockchain-and-disruption-in-the-financial-world-will-banks-survive [Accessed:16 September 2020].

Finlay, L. 2021. Thematic analysis: The 'good' the 'bad' and the 'ugly'. *European Journal for Qualitative Research in Psychotherapy*, 11:103-116.

Floros, E.J. 2021. *The financial revolution*: *Bitcoin, blockchain and the democratisation of wealth*. KDP.

Flovik, S., Moudnib, R.A.R. & Vassilakopoulou, P. 2021. Determinants of blockchain technology introduction in organisations: An empirical study among experienced practitioners. *Procedia Computer Science*, 181(1877):664-670. doi.org/10.1016/j.procs.2021.01.216

Friedman, N. & Ormiston, J. 2022. Blockchain as a sustainability-oriented innovation?: Opportunities for and resistance to blockchain technology as a driver of sustainability in global food supply chains. *Technological Forecasting and Social Change*, 175:1-17. doi.org/10.1016/j.techfore.2021.121403

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*, 51:1-14. doi.org/10.1016/j.ijinfomgt.2019.10.014

Gallagher, R. 2019. *Twitter helped Chinese government promote disinformation on repression on Uyghurs*. [Online]. Available at: https://theintercept.com/2019/08/19/twitter-ads-china-uighurs/ [Accessed: 16 June 2021].

Gallagher, R. & Greenwald, G. 2014. *How the NSA plans to infect 'millions' of computers with malware.* The intercept. [Online]. Available at: https://firstlook.org/theintercept/article/2014/03/12/nsa-plans-infect-millions-computers-malware/ [Accessed: 16 June 2021].

Gangwar, H., Date, H. & Raoot, A.D. 2014. Review on IT adoption: Insights from recent technologies. *Journal of Enterprise Information Management*, 27(4):488-502. doi.org/10.1108/JEIM-06-2012-0028

Gans, R.B., Ubacht, J. & Janssen, M. 2022. Governance and societal impact of blockchain-based self-sovereign identities. *Policy and Society,* 41(3):402-413. doi.org/10.1093/polsoc/puac018

Garg, N. & Rao, R. 2023. A case for integrating blockchain-based smart contracts in cross-border Investments. *SSRN Electronic Journal*, 16:1-51. doi.org/10.1016/j.techfore.2020.120407

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*, 163:1-18. doi.org/10.1016/j.techfore.2020.120407

GDPR.EU. 2022. *Everything you need to know about the 'right to be forgotten'*. [Online]. Available at: https://gdpr.eu/right-to-be-forgotten/ [Accessed: 2 June 2022].

Ghosh, K. 2021. Blockchain technology: A catalyst for change in finance. *A Management Journal*, 12(1):1-22.

Given, L.M. 2008. *Sage Encyclopaedia of qualitative research methods.* California: Sage.

Gökalp, E., Gökalp, M.O. & Çoban, S. 2022. Blockchain-based supply chain management: Understanding the determinants of adoption in the context of organisations. *Information Systems Management*, 39(2):100-121. doi.org/10.1080/10580530.2020.1812014.

Goncalves, P. 2020. *Banks to adopt blockchain in the next three to five years.* [Online]. Available at: https://www.internationalinvestment.net/news/4011241/banks-adopt-blockchain-jpmorgan%0ABanks. [Accessed: 15 May 2021].

Goswami, S. 2017. *Scalability analysis of blockchains through blockchain simulation*. Master's thesis, University of Nevada, Las Vegas.

Graneheim, U.H. & Lundman, B. 2004. Qualitative content analysis in nursing research: Concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today*, 24(2):105112. doi.org/10.1016/j.nedt.2003.10.001

Gray, J. 2018. *The effect of blockchain technology on the South African banking environment*. Master's thesis, University of Witwatersrand, South Africa.

Gray, P.S., Williamson, J.B., Karp, D.A. & Dalphin, J.R. 2007. *The research imagination – An introduction to qualitative and quantitative methods*. New York: Cambridge.

Grix, J. 2019. *The foundations of research*. 3rd ed. London: Red Global.

Grosse, R.E. 2011. The global financial crisis – A behavioural view. *SSRN Electronic Journal,* 1-27.

Guba, E.G. & Lincoln, Y.S. (eds.). 1994. *Competing paradigms in qualitative research*. In N.K. Denzin & Y.S. Lincoln (eds.), *Handbook of qualitative research.* London: Sage, 105-117.

Guo, Y. & Liang, C. 2016. Blockchain application and outlook in the banking industry. *Financial Innovation*, 2(1):1-12. doi.org/10.1186/s40854-016-0034-9

Gupta, A. & Gupta, S. 2020. Blockchain technology application in Indian banking sector. *Delhi Business Review,* 19(2):1-10. doi.org/10.1515/ci-2020-0304

Gupta, M. 2017. *Blockchain for Dummies IBM limited edition*. Hoboken: Wiley.

Gupta, R., Ranjan, S. & Kukreja, G. 2021. *Fusion of blockchain and IoT: The future of industry 4.0*. In T. Choudhury, A. Khanna, T.T. Toe, M. Khurana, N. Gia Nhu (eds.), *Blockchain applications in IoT ecosystem.* EAI/Springer Innovations in Communication and Computing. Cham: Springer. doi.org/10.1007/978-3-030-65691-1_3

Habib, G., Sharma, S., Ibrahim, S., Ahmad, I., Qureshi, S. & Ishfaq, M. 2022. Blockchain technology: Benefits, challenges, applications, and integration of blockchain technology with cloud computing. *Future Internet*, 14(11):1-22. doi.org/10.3390/fi14110341

Haile, E.G. 2014. *Assessment on causes of delay in managing international banking transaction: The case of Lion International Bank S.C.* Bachelor's thesis, St Mary's University, Addis Ababa.

Hair, J.F., Page, M. & Brunsveld, N. 2020. *Essentials of business research methods.* 4th ed. New York: Routledge.

Halilbegovic, S. & Arapovic, A.O. 2019. Exploratory analysis of blockchain application in trade finance. *European Journal of Economic Studies*, 8(2):110-119. doi.org/10.13187/es.2019.2.110

Hammarberg, K., Kirkman, M. & De Lacey, S. 2016. Qualitative research methods: When to use them and how to judge them. *Human Reproduction*, 31(3):498-501. doi.org/10.1093/humrep/dev334

Harker, P.T. & Zenios, S.A. 1999. *What drives the performance of financial institutions?* In P.T. Harker & S.A. Zenios (eds.), *Performance of financial institutions*. Madrid: Cambridge, 3-31.

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

Hayes, A. 2019. *Blockchain technology to revolutionise traditional banking banks are taking notice*. [Online]. Available at: https://www.investopedia.com/articles/investing/083115/blockchain-technology-revolutionize-traditional-banking.asp%0AGuide [Accessed: 14 September 2020].

Hayes, B.K., Heit, E. & Swendsen, H. 2010. Inductive reasoning. *Wiley Interdisciplinary Reviews: Cognitive Science*, 1(2):278-292. doi.org/10.1002/wcs.44

Heidari, H., Alborzi, M., Radfar, R., Mousakhani, M. & Divandari, A. 2020. Explaining the blockchain acceptance indices in Iran financial markets: A fuzzy Delphi study. *Journal of Money and Economy,* 14(3):335-365.

Heires, K. 2016. *The risks and rewards of blockchain technology.* [Online]. Available at: https://www.rmmagazine.com/articles/article/2016/03/01/-The-Risks-and-Rewards-of-Blockchain-Technology [Accessed: 17 June 2021].

Hewa, T., Ylianttila, M. & Liyanage, M. 2021. Survey on blockchain based smart contracts: Applications, opportunities and challenges. *Journal of Network and Computer Applications*, 177:2-59. doi.org/10.1016/j.jnca.2020.102857

Hilary, G. & Liu, L.X. 2021. Blockchain and other distributed ledger technologies in finance. In R. Rau, R. Wardrop & L. Zingales (eds.), *The Palgrave handbook of technological finance*. Cham: Palgrave Macmillan. doi.org/10.1007/978-3-030-65117-6_10

Hill, C., Sims, S., Robert, M. & Collier, S. 2022. A thematic analysis of staff perspectives on the impact of a mental health nurse (RMN) in a critical care unit. *Journal of the Intensive Care Society*, 24(3):292-298, doi.org/10.1177/17511437221116474

Himeur, Y., Sayed, A., Alsalemi, A., Bensaali, F., Amira, A., Varlamis, I., Eirinaki, M., Sardianos, C. & Dimitrakopoulos, G. 2022. Blockchain-based recommender systems: Applications, challenges and future opportunities. *Computer Science Review*, 43:1-21. doi.org/10.1016/j.cosrev.2021.100439

Holotiuk, F. & Moormann, J. 2019. Dimensions, success factors and obstacles of the adoption of blockchain technology. In *Australasian Conference on Information Systems*, Perth, Western Australia,162-172.

Holotiuk, F., Pisani, F. & Moormann, J. 2017. The impact of blockchain technology on business models in the payments industry. *Proceedings of the 13th International Conference on Wirtschaftsinformatik, (WI 2017),* St. Gallen, 912-926.

Hossein, M.H. & Khodaei, A. 2024. New methods of business income generation under emerging technologies. *Mathematical Statistician and Engineering Applications*, 72(2):256-274.

Huang, R. 2019. *Central banks are using blockchain to stabilise the global financial system.* [Online]. Available at: https://www.forbes.com/sites/rogerhuang/2019/06/23/central-banks-are-using-blockchain-to-stabilize-the-global-financial-system/?sh=5484cdb459d5 [Accessed: 22 April 2020].

Iansiti, M. & Lakhani, K.R. 2017. *The truth about blockchain*. [Online]. Available at: https://enterprisersproject.com/sites/default/files/the_truth_about_blockchain [Accessed: 19 September 2020].

ICAEW *see* The Institute of Chartered Accountants in England and Wales.

Ide, N. and Pustejovsky, J., 2010, January. What does interoperability mean, anyway? Toward an operational definition of interoperability for language technology. In *Proceedings of the Second International Conference on Global Interoperability for Language Resources. Hong Kong, China*.

Idrees, S.M., Aijaz, I., Jameel, R. & Nowostawski, M. 2021. Exploring the blockchain technology: Issues, applications and research potential. *International journal of Online and biomedical Engineering*, 17(7):48-69. doi.org/10.3991/ijoe.v17i07.22803

Iredale, G. 2020. *Top disadvantages of blockchain technology.* 101 Blockchains. [Online]. Available at: https://101blockchains.com/wp-content/uploads/2020/04/Disadvantages-of-Blockchain-Technology.png [Accessed: 17 September 2021].

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. doi.org/10.1016/j.ijinfomgt.2019.08.012

Javaid, M., Haleem, A., Singh, R.P., Suman, R. & Khan, S. 2022. A review of blockchain technology applications for financial services. *BenchCouncil Transactions on Benchmarks, Standards and Evaluations*, 2(3): 100073. doi.org/10.1016/j.tbench.2022.100073

Jiaying, J. 2019. Regulating blockchain? A retrospective assessment of China's blockchain policies and regulations. *Tsinghua China Law Review*, 12(2):315-364.

Kapur, R. 2018. *Research methodology: Methods and strategies.* University of Delhi, India. https://www.researchgate.net/publication/324588113_Research_Methodology_Methods_and_Strategies [Accessed: 20 October 2024].

Karahanna, E., Straub, D.W. & Chervany, N.L. 1999. Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS Quarterly: Management Information Systems*, 23(2):183-213.

doi.org/10.2307/249751

Kasturi, S. 2023. Evolving consumer expectations and the future of digital banking. *Journal of Digital Banking*, 8(1):37-48. doi.org/10.69554/LURA3454

Kaushal, R.K., Kumar, N. & Panda, S.N. 2021. Blockchain technology, its applications and open research challenges. *Journal of Physics: Conference Series*, 1950(1):1-7. doi.org/10.1088/1742-6596/1950/1/012030

Kawasmi, Z., Gyasi, E.A. & Dadd, D. 2020. Blockchain adoption model for the global banking industry. *Journal of International Technology and Information Management*, 28(4-5):112-154.

Khadka, R. 2020. *The impact of blockchain technology in banking: How can blockchain revolutionise the banking industry?* Theseus. https://www.theseus.fi/handle/10024/346030 [Accessed: 12 March 2024].

Khalil, M., Khawaja, K.F. & Sarfraz, M. 2022. The adoption of blockchain technology in the financial sector during the era of fourth industrial revolution: A moderated mediated model. *Quality and Quantity*, 56(4):2435-2452. doi.org/10.1007/s11135-021-01229-0

Khan, M.M, Nisar, K., Farooq, Y., Habib, S., Habib, S., Danish, M. & Hyder, I. 2021. An improved banking application model using blockchain. *Research Square,* 1-21. doi.org/10.21203/rs.3.rs-582543/v1 (Check in-text as well)

Khan, N. 2020. *Blockchain-enabled traceability and immutability for financial applications*. PhD dissertation, Université du Luxembourg.

Kharpal, A. 2017. *Blockchain technology is moving into the financial mainstream with IBM and seven European banks.* [Online]. Available at: https://www.cnbc.com/2017/06/26/ibm-building-blockchain-for-seven-major-banks-trade-finance.html [Accessed: 13 August 2022].

Khatwani, R., Mishra, M., Bedarkar, M., Nair, K. & Mistry, J. 2023. Impact of blockchain on financial technology innovation in the banking, financial services and insurance (BFSI) sector. *Journal of Statistics Applications and Probability*, 12(1):181-189. doi.org/10.18576/jsap/120117

Kiger, M.E. & Varpio, L. 2020. Thematic analysis of qualitative data: AMEE Guide No. 131. *Medical Teacher*, 42(8):846-854. doi.org/10.1080/0142159X.2020.1755030

Kılıç, Ç. & Aydın, M.N. 2018. Future agenda of blockchain perceived by three important communities: Academia, enablers, industry. *Fifth International Management Information Systems Conference,* Ankara, Turkey, 24-26 October, 20-24.

Kim, B.T.S. & Hyun, E.J. 2023. Mapping the landscape of blockchain technology knowledge: A patent co-citation and semantic similarity approach. *Systems*, 11(3):1-28. doi.org/10.3390/systems11030111

Kim, J.S. & Shin, N. 2019. The impact of blockchain technology application on supply chain partnership and performance. *Sustainability (Switzerland)*, 11(21):1-17. doi.org/10.3390/su11216181

Kivunja, C. & Kuyini, A.B. 2017. Understanding and applying research paradigms in

educational contexts. *International Journal of Higher Education*, 6(5):26-41. doi.org/10.5430/ijhe.v6n5p26

Kochetkova, M. 2020. *Blockchain in the art market: Opportunities and challenges*. Bachelor's Thesis, LAB University Of Applied Sciences, Finland.

Kolehmainen, T., Laatikainen, G., Kultanen, J., Kazan, E. & Abrahamsson, P. 2020. Using blockchain in digitalising enterprise legacy systems: An experience report. *Environmental Modelling and Software*, 144(2):1-17. doi.org/10.1007/978-3- 030-67292-8_6

Kothari, C.R. 1985. *Research methodology methods and techniques*. 2nd ed. New Delhi: New Age.

Kuklii, D. & Rudnytska, T. 2020. *Blockchain technology as a reliable method of information protection*. [Online]. Available at: https://ir.lib.vntu.edu.ua/bitstream/handle/123456789/29682/9544.pdf [Accessed: 15 June 2024].

Kumar, R. 2018. *Research methodology a step by step guide for beginners*. 3rd ed. London: Sage.

Kumar, S., Kumar, B., Nagesh, Y., Gborse, F.C. & Sogah, E. 2022. Application of blockchain technology as a support tool in economic & financial development. *British Journal of Management*, 58(1):198-211.

Kumari, A. & Devi, N.C. 2022. The impact of fintech and blockchain technologies on banking and financial services. *Technology Innovation Management Review*, 12(1/2):1-11. doi.org/10.22215/timreview/1481

Kumatongo, B. & Muzata, K.K. 2021. Research paradigms and designs with their application in education. *Journal of Lexicography and Terminology,* 5(1):16-32.

Lamb, K. 2020. *Take a deeper look at national payment systems*. [Online]. Available at: https://www.investopedia.com/articles/economics/08/nps.asp [Accessed: 05 November 2020].

Lance, P.M. & Hattori, A. 2016. *Sampling and evolution: A guide to sampling for program impact evaluation*. Chapel Hill: Measure.

Łasak, P. & Wyciślak, S. 2023. Blockchain and cloud platforms in banking services: A paradox perspective. *Journal of Entrepreneurship, Management and Innovation*, 19(4):12-47. doi.org/10.7341/20231941

Laurence, T. 2017. *Blockchain for dummies*. Hoboken: Wiley.

Lee, Y., Hsieh, Y. & Hsu, C. 2011. Adding innovation diffusion theory to the technology acceptance model: Supporting employees' intentions to use e-learning systems. In A. Kinshuk, D.G. Sampson & N.-S. Chen (eds.), *Educational Technology and society*. Madrid: Delta, 124-137.

Leighton, J.P. 2004. *Defining and describing reason*. In J.P. Leighton & R.J. Sternberg (eds.), *The basics of reasoning*. New York: Cambridge, 3-11.

Liao, C.H., Guan, X.Q., Cheng, J.H. & Yuan, S.M. 2022. Blockchain-based identity management and access control framework for open banking ecosystem. *Future Generation Computer Systems*, 135:450-466. doi.org/10.1016/j.future.2022.05.015

Lincoln, Y.S. & Guba, E.G. 1985. *Naturalistic inquiry*. California: Sage.

Lindman, J., Berryhill, J., Welby, B. & Piccinin, M. 2020. *The uncertain promise of blockchain for government*. OECD Working Papers on Public Governance, No. 43. Paris: OECD. doi.org/10.1787/d031cd67-en

Lippert, S.K. & Govindarajulu, C. 2006. Technological, organisational and environmental antecedents to web services adoption. *Communications of the IIMA*, 6(1):146-158.

Louati, H., Louati, A., Almekhlafi, A., Elsaka, M., Alharbi, M., Kariri, E. & Altherwy, Y.N. 2024. Adopting artificial intelligence to strengthen legal safeguards in blockchain smart contracts: A Strategy to mitigate fraud and enhance digital transaction security. *Journal of Theoretical and Applied Electronic Commerce Research,* 19:2139-2156. doi.org/10.3390/jtaer19030104

Lovelock, J.-D., Reynolds, M., Granetto, B. & Kandaswamy, R. 2017. *Forecast: Blockchain business value, worldwide, 2017-2030. Gartner.* https://www.gartner.com/en/documents/3627117 [Accessed: 19 June 2022].

Lu, Y. 2019. Artificial intelligence: A survey on evolution, models, applications and future trends. *Journal of Management Analytics*, 6(1):1-29. doi.org/10.1080/23270012.2019.1570365

Lustenberger, M., Maleševi, S. & Spychige, F. 2021. Ecosystem readiness: Blockchain adoption is driven externally. *Frontiers in Blockchain,* 4:1-19. doi.org/10.3389/fbloc.2021.720454

Lynch, G. 2008. *Sampling*. [Online]. Available at: https://research.kent.ac.uk/religion-methods/topics/sampling/ [Accessed: 26 September 2029].

MacDonald, T.J., Allen, D.W.E. & Potts, J. 2016. *Blockchains and the boundaries of self-organised economies: Predictions for the future of banking.* In P. Tasca, T. Aste, L. Pelizzon & N. Perony (eds.), *Banking beyond banks & money*. Springer, 279-296.

MacLean, M. 2013. Cracks in the (self-constructed?) ghetto walls? Comments on Paul Ward's last man picked. *International Journal of the History of Sport,* 30(1):23-34. doi.org/10.1080/09523367.2012.743996

Mahmood, Z. 2021. *Industry use cases on blockchain technology applications in IoT and the financial sector*. Hershey, PA, USA: IGI Global.

Mahmudnia, D., Arashpour, M. & Yang, R. 2022. Blockchain in construction management: Applications, advantages and limitations. *Automation in Construction*, 140:2-10. doi.org/10.1016/j.autcon.2022.104379

Makokha, F. 2020. Vote validation using blockchain technology: A conceptual use case. *European Journal of Electrical Engineering and Computer Science*, 4(4):1-10. doi.org/10.24018/ejece.2020.4.4.233

Mane, P.B. & Nikam, S.S. 2019. *Basic instrumentation*. In V. Bairagi &M.V. Munot (eds.),

Research methodology: A Practical and scientific approach. New York: CRC, 99-160.

Mantere, S. & Ketokivi, M. 2013. Reasoning in organisation science. *Academy of Management Review,* 38(1):70-89. doi.org/10.1090/S0002-9904-1919-03192-9

Maryniak, A., Bulhakova, Y., Lewoniewski, W. & Bal, M. 2021. Creating resilient supply chains using combination of blockchain technology and different 4.0 technologies. In A. Lopata, D. Gudonienė & R. Butkienė (eds.), *Information and software technologies.* ICIST 2021. Communications in Computer and Information Science, vol. 1486. Cham: Springer. doi.org/10.1007/978-3-030-88304-1_2

Mayer, R., Davis, J. & Schoorman, F.D. 1995. An integrative model of organisational trust. *International Journal of Innovation Management*, 20(3):709-734. doi.org/10.1142/S1363919618500172

Michael, J.P. & Richard, M.F. 2013. Inductive teaching and learning methods: Definitions, comparisons, and research bases. *Journal of Engineering Education*, 95(2):123-138.

Mishra, L. & Kaushik, V. 2023. Application of blockchain in dealing with sustainability issues and challenges of financial sector. *Journal of Sustainable Finance & Investment*, 13(3):1318-1333. doi.org/10.1080/20430795.2021.1940805

Morgan, H. 2022. Understanding thematic analysis and the debates involving its use. *Qualitative Report*, 27(10):2079-2091. doi.org/10.46743/2160-3715/2022.5912

Moser, A. & Korstjens, I. 2018. Series: Practical guidance to qualitative research. Part 3: sampling, data collection and analysis. *European Journal of General Practice*, 24(1):9-18. doi.org/10.1080/13814788.2017.1375091

Muganda, L., Ondulo, J. & Rambim, D. 2020. Technological decentralisation and livestock data management in Kenya: The moderating effect of blockchain technology. *International Journal of Advanced Research in Computer and Communication Engineering*, 9(5):42-48. doi.org/10.17148/IJARCCE.2020.9509

Mukherjee, P. & Pradhan, C. 2021. *Blockchain 1.0 to 4.0 – The evolutionary transformation of blockchain technology.* In S.K. Panda, S.K. Swain, A.K. Jena & S.C. Satapathy (eds.), *Blockchain technology: Applications and challenges.* Intelligent Systems Reference Library, vol 203. Cham: Springer.

Nakamoto, S. 2020. *Bitcoin: A peer-to-peer electronic cash system.* [Online]. Available at: https://www.klausnordby.com/bitcoin/Bitcoin_Whitepaper_Document_HD.pdf [Accessed: 12 March 2022].

Nandakumar, G.S., Cederquist, J. & Hybrid. 2021. *Blockchain and the battlefield*. In Z.S. Davis, F. Gac, C. Rager, P. Reiner & J. Snow (eds.), *Strategic latency unleashed: The role of technology in a revisionist global order and the implications for special operations forces.* Lawrence Livermore National Laboratory.

Nassaji, H. 2015. Qualitative and descriptive research: Data type versus data analysis. *Language Teaching Research*, 19(2):129-132. doi.org/10.1177/1362168815572747

Nayak, J.K. & Singh, P. 2015. *Fundamentals of research methodology*. New Delhi: SSDN.

Negi, S. 2024. A blockchain technology for improving financial flows in humanitarian supply chains: Benefits and challenges. *Journal of Humanitarian Logistics and Supply Chain Management.* Vol. ahead-of-print No. ahead-of-print. doi.org/10.1108/JHLSCM-10-2023-0099

Nelms, T.C., Maurer, B., Swartz, L. & Mainwaring, S. 2018. Social payments: Innovation, trust, bitcoin, and the sharing economy. *Theory, Culture and Society*, 35(3):13-33. doi.org/10.1177/0263276417746466

Nguyen, Q.K. 2016. Blockchain – A financial technology for future sustainable development. *Proceedings of the 3rd International Conference on Green Technology and Sustainable Development (GTSD 2016),* Kaohsiung, Taiwan, 51-54.

Nielsen, K., Randall, R. & Albertsen, K. 2007. Participants' appraisals of process issues and the effects of stress management interventions. *Journal of Organisational Behaviour*, 28(6):793-810. doi.org/10.1002/job.450

Nimmagadda, V. 2021. Artificial intelligence and blockchain integration for enhanced security in insurance: Techniques, models, and real-world applications. *African Journal of Artificial Intelligence and Sustainable Development*, 1(2):187-223.

Nola, R. & Sankey, H. 2007. *Theories of scientific method*. Stocksfield: Acumen.

Noor, A. 2022. Adoption of blockchain technology facilitates a competitive edge for logistic service providers. *Sustainability (Switzerland)*, 14(23): 15543. doi.org/10.3390/su142315543

Ogunwole, O., Onukwulu, E.C., Joel, M.O., Ewim C.P. & Adaga, E.M. 2024. Digital Transformation in Supply Chain Management: Leveraging Blockchain for Transparency and Sustainability. *Iconic Research and Engineering Journals*, 8(3):848-857

Olsen, W. 2012. *Key debates and methods in social research.* London: Sage.

Orrell, D. 2016. *The evolution of money*. New York: Columbia University.

Oyewole, A., Oguejiofor, B., Eneh, N., Akpuokwe, C. & Bakare. S. 2024. Data privacy laws and their impact on financial technology companies: A review. *Computer Science & IT Research Journal*, 5(3):628-650. doi.org/10.51594/csitrj.v5i3.911

Padilla, P., Vonortas, N., Dranev, Y., Belousova, V. & Boudard, E. 2020. *Analysing the deployment of blockchain and distributed ledger technologies in the financial sector*. Report prepared as a background paper for the World Bank Group flagship report 'Europe 4.0: Addressing the Digital Dilemma'. N-Able.

PASA. 2019. *Payments association of South Africa annual report*. [Online]. Available at: https://pasa.org.za/pasa-annual-report-2016/ [Accessed: 05 November 2020].

Patton, M.Q. 2015. *Qualitative research & evaluation methods: Integrating theory and practice*. 4th ed. California: Sage.

Peersman, G. 2014. *Overview: Data collection and analysis methods in impact evaluation.* Methodological Briefs Impact Evaluation No. 10. Florence: UNICEF Office of Research.

Pilbauer, J., Pretorius, M., Maritz, C., Jain, S., Alexander, V. & Crafford, P. 2019. *Payments study tour report 2019.* [Online]. Available at: https://www.strategyand.pwc.com/za/en/assets/pdf/payments-study-tour-2019 [Accessed: 04 November 2020].

Pilipinas, B.S.N. 2021. *Payments and adjustments.* [Online]. Available at: https://www.bsp.gov.ph/SitePages/PaymentsAndSettlements/PaymentsAndSettlements.aspx [Accessed: 13 December 2021].

Pilkington, M. 2016. *Blockchain technology: Principles and applications*. In F.X. Olleros & M. Zhegu (eds.), *Research handbook on digital transformations.* Cheltenham: Edward Elgar, 225-254.

Ponterotto, J.G. 2005. Qualitative research in counselling psychology: A primer on research paradigms and philosophy of science. *Journal of Counselling Psychology*, 52(2):126-136. doi.org/10.1037/0022-0167.52.2.126

Pruzan, P. 2016. *Research methodology: The aims, practices and ethics of science*. Springer.

Punch, K.F. 1998. *Introduction to social research: quantitative qualitative research*. London: *Sage*.

QuestionPro. 2022. Data collection methods: definition, examples and sources. [Online]. Available at: https://www.questionpro.com/blog/data-collection-methods/ [Accessed: 1 July 2022].

Rabianski, J. 2003. Primary and secondary data: Concepts, concerns, errors, and issues. *The Appraisal Journal*, 71(1):43-55.

Raghavendra, G. & Lingam, M.S. 2024. Blockchain technology in digital advertising: transparency, fraud prevention and trust. *Educational Administration: Theory and Practice*, 30(4):3041-3049. doi.org/10.53555/kuey.v30i4.1477

Rane, J., Kaya, Ö., Mallick, S.K. & Rane, N.L. 2024a. Enhancing customer satisfaction and loyalty in service quality through artificial intelligence, machine learning, internet of things, blockchain, big data, and ChatGPT. *Generative Artificial Intelligence in Agriculture, Education, and Business*, (2024):84-141. doi.org/10.70593/978-81-981271-7-4_3

Rane, J., Kaya, Ö., Mallick, S.K. & Rane, N.L. 2024b. Influence of digitalisation on business and management: A review on artificial intelligence, blockchain, big data analytics, cloud computing, and Internet of Things. *Generative Artificial Intelligence in Agriculture, Education, and Business*, 5:1-26. doi.org/10.70593/978-81-981271-7-4_1

Rani, K.N., Pravallika, S.K., Nadiya, T., Poojitha & K. Greeshma. 2021. Blockchain technology in healthcare: Challenges and opportunities. *International Journal of Healthcare and Biological Sciences*, 3(3):51-55. doi.org/10.46795/ijhcbs.v3i3.334

Ratheesh & Nair, K. 2021. Ready to payments bank after demonetisation an exploratory research on adoption of India post payments bank among postal banking customers in Kollam-Kerala. *Journal on Emerging trends in Modelling and Manufacturing*, 7(4):125-134. doi.org/10.46632/7/4/4

Ravindran, U. & Vamsi, P.R. 2021. A secure blockchain based finance application. *Proceedings of the 2021 Thirteenth International Conference on Contemporary Computing (IC3-2021),* 99-109. doi.org/10.1145/3474124.3474138 [Accessed: 28 October 2024].

Republic of South Africa. 2013. Protection of Personal Information Act 4 of 2013. *Government Gazette*, 37067:2-146, 26 November.

Resnik, D.B. 2015. *What is ethics in research & why is it important?* National Institute of Environmental Health Sciences [Online]. Available at: https://www.researchgate.net/publication/242492652_What_is_Ethics_in_Research_Why_Is_It_Important [Accessed: 15 June 2022].

Reyna, A., Martín, C., Chen, J., Soler, E. & Díaz, M. 2018. On blockchain and its integration with IoT. Challenges and opportunities. *Future Generation Computer Systems*, 88:173-190. doi.org/10.1016/j.future.2018.05.046

Rice, T. & Von Peter, G. 2020. On the global retreat of correspondent banks. *BIS Quarterly Review*, (March): 37-52.

Riger, S. & Sigurvinsdottir, R. 2016. Thematic analysis. In L.A. Jason & D.S. Glenwick (eds.), *Handbook of methodological approaches to community-based research: Qualitative, Quantitative, and mixed methods*. New York: Oxford. doi.org/10.1093/med:psych/9780190243654.003.0004

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. doi.org/10.1007/s12599-017-0506-0

Rogers, E.M. 1983. *Diffusion of innovations*. 3rd ed. The Free Press.

Blackduck. 2024. *What is blockchain and how does it work.* [Online]. Available at:. https://www.blackduck.com/glossary/what-is-blockchain.html [Accessed 01 December 2024].

Ryan, V. 2019. *Google is deepening its involvement with Egypt's repressive government.* [Online]. Available at: https://theintercept.com/2019/08/18/google-egypt-office-sisi/ [Accessed: 16 June 2021].

Sachitra, V. & Dayaratna, D. 2023. Examine the feasibility of implementing blockchain technology in the Sri Lankan banking system. *Asian Journal of Advanced Research and Reports*, 17(9):115-125. doi.org/10.9734/AJARR/2023/v17i9524

Saha, K.K. 2021. *An analysis of adoption of blockchain technology in the private banking sector of Bangladesh*. Master's dissertation, BRAC University, Bangladesh. http://hdl.handle.net/10361/14883

Salzano, F., Pareschi, R., Marchesi, L. & Tonelli, R. 2023. Blockchain-based Information ecosystems. *CEUR Workshop Proceedings (DLT2023): Distributed Ledger Technology,* Bologna, Italy, 25-26 May 2023.

Sankar, L.S., Sindhu, M. & Sethumadhavan, M. 2017. Survey of consensus protocols on blockchain applications. *Proceedings of the International Conference on Advanced Computing and Communication Systems (ICACCS -2017),* Coimbatore, India, 6-7

January 2017.

Sankaranarayanan, G. 2020. Usage of blockchain in banking sector and its implications on Indian economy. *Alochana Chakra Journal,* 9(5):7383-7389.

Sanyaolu, T.O., Adeleke, A.G., Azubuko, C.F. & Osundare, O.S. 2024. Harnessing blockchain technology in banking to enhance financial inclusion, security, and transaction efficiency. *International Journal of Scholarly Research in Science and Technology*, 5(1):035-053. doi.org/10.56781/ijsrst.2024.5.1.0032

Saripalli, S.H. 2021. Transforming government banking by leveraging the potential of blockchain technology. *Journal of Banking and Financial Technology*, 5(2):135-142. doi.org/10.1007/s42786-021-00035-4

Satija, R. & Antony, A. 2018. *Banks turn to blockchain to speed up Indian internal trade deals.* [Online]. Available at: https://www.bloomberg.com/news/articles/2018-06-06/banks-turn-to-blockchain-to-speed-up-indian-internal-trade-deals#xj4y7vzkg 28 [Accessed: 17 August 2022].

Saunders, M., Lewis, P. & Thornhill, A. 2007. *Research methods for business students.* 4th ed. London: Pearson Education.

Saunders, M., Lewis, P. & Thornhill, A. 2019. *Research methods for business students*, 8th ed. London: Pearson

Schofield, W. 2006. *Survey sampling*. In R. Sapsford & V. Jupp (eds.), Data collection and analysis. 2nd ed. London: Sage.

Schramm, W. 1971. *Notes on case studies of instructional media projects.* Working paper for the Academy for Educational Development, 1-43. ERIC Number: ED092145. https://eric.ed.gov/?id=ED092145.

Sedgwick, P. 2014. Unit of observation versus unit of analysis. *BMJ (Online)*, 348:1-3. doi.org/doi.org/10.1136/bmj.g3840

Sharma, T.K. 2019. *Blockchain council*. [Online]. Available at: https://www.blockchain-council.org/blockchain/top-10-countries-leading-blockchain-technology-in-the-world/ [Accessed: 1 September 2020].

SheCanCode. 2018. *An introduction to blockchain & distributed ledgers.* [Online]. Available at: https://www.shecancode.io/blog/an-introduction-to-blockchain-distributed-ledgers [Accessed: 29 March 2021].

Shen, L. 2016. *Blockchain will be used by 15% of big banks by 2017.* [Online]. Available at: https://fortune.com/2016/09/28/blockchain-banks-2017/ [Accessed: 3 May 2020].

Shkedi, A. 2019. *Introduction to data analysis in qualitative research: Practical and theoretical methodologies with optional use of a software tool*. [Online]. Available at: https://www.amazon.com/Data-Analysis-Qualitative-Research-Methodologies/dp/1790521734 [Accessed: 14 November 2023].

Shojaei, R.S. & Burgess, G. 2022. Non-technical inhibitors: Exploring the adoption of digital innovation in the UK construction industry. *Technological Forecasting & Social Change*, 1-14. doi.org/10.1016/j.techfore.2022.122036

Silverman, S. & Solmon, M. 1998. The unit of analysis in field research: Issues and approaches to design and data analysis. *Journal of Teaching in Physical Education*, 17(3):270-284. doi.org/10.1123/jtpe.17.3.270

Singh, M. & Ausaf, M. 2022. *Transactions in banking sector using blockchain technology.* EasyChair Preprint. https://easychair.org/publications/preprint/NPXQ.

Singh, M. & Woodrow, C. 2010. *A research evaluation of the school-centred community hub initiative.* Penrith, N.S.W.: University of Western Sydney.

Singh, S.K. & Vadi, V.R. 2022. Evolutionary transformation of blockchain technology. *International Journal of Engineering Research & Technology (IJERT),* 10(1):26-30.

Sneha, K., Manu, M.R., Balamurugan, B. & Sreeji, S. 2021. Blockchain identity management. In K. Saini, P.R. Chelliah D.K. & Saini (eds.), *Essential enterprise blockchain concepts and applications.* Florida: CRC Press, 123-142

South African Banking Risk Information Centre. 2022. *Debit order schemes*. [Online]. Available at: https://www.sabric.co.za/stay-safe/debit-order-scams/ [Accessed: 11 August 2022].

South African Government. 1996. *The Constitution of the Republic of South Africa*. [Online]. Available at: https://www.gov.za/documents/constitution/constitution-republic-south-africa-1996-04-feb-1997 [Accessed: 3 September 2024].

Sun, J., Yan, J. & Zhang, K.Z.K. 2016. Blockchain-based sharing services: What blockchain technology can contribute to smart cities. *Financial Innovation*, 2(1):1-19. doi.org/10.1186/s40854-016-0040-y

Swan, M. 2015. *Blockchain: Blueprint for a new economy*. California: O'Reilly Media.

Swathi, G. & Pahuja, A. 2023. FinTech frontiers: Cloud computing and artificial intelligence applications for intelligent finance investment and blockchain in the financial sector. *International Journal of Intelligent Systems and Applications in Engineering (IJISAE)*, 12(4S), 654659.

Taherdoost, H. 2018. A review of technology acceptance and adoption models and theories. *Procedia Manufacturing*, 22:960-967. doi.org/10.1016/j.promfg.2018.03.137

Taherdoost, H. 2022. A critical review of blockchain acceptance models—Blockchain technology adoption frameworks and applications. *Computers*, 11:1-31. doi.org/10.3390/computers11020024

Taherdoost, H. 2023. Smart contracts in blockchain technology: A critical review. *Information (Switzerland)*, 14(2):1-19. doi.org/10.3390/ info14020117

Talkative. 2022. *Customer service vs. customer experience*. [Online]. Available at: https://disneyinstitute.com/blog/2013/03/customer-service-vs-customer-experience/148/ [Accessed: 22 October 2024].

Tapscott, A. & Tapscott, D. 2017. *How blockchain is changing finance.* Harvard Business Review. [Online]. Available at: https://hbr.org/2017/03/how-blockchain-is-changing-finance [Accessed: 26 September 2020].

Tapscott, D. & Tapscott, A. 2018. *Blockchain revolution: How the technology behind bitcoin and other cryptocurrencies is changing the world*. New York: Portfolio/Penguin.

Taskinsoy, J. 2020. From primitive barter to inflationary dollar: A warless economic weapon of mass destruction. *SSRN Electronic Journal*, 1–50. doi.org/10.2139/ssrn.3542145

Taskinsoy, J. 2021a. Bitcoin: A new digital gold standard in the 21st century? *SSRN Electronic Journal*, 2-60. doi.org/10.2139/ssrn.3941857

Taskinsoy, J. 2021b. Bitcoin nation: The world's new 17th largest economy. *SSRN Electronic Journal,* 1-25.

Taufiq, R., Hidayanto, A.N. & Prabowo, H. 2018. The affecting factors of blockchain technology adoption of payments systems in Indonesia banking industry. *Proceedings of the International Conference on Information Management and Technology (ICIMTech)*, Jakarta, Indonesia, 3-5 September.

Teddlie, C. & Tashakkori, A. 2009. *Foundations of mixed methods research integrating quantitative and qualitative approaches in the social and behavioral sciences*. California: Sage.

Teisserenc, B. & Sepasgozar, S. 2021. Adoption of blockchain technology through digital twins in the construction industry 4.0: A Pestels approach. *Buildings*, 11:1-18. doi.org/10.3390/buildings11120670

Thanh, N.C., Thi, T. & Thanh, L. 2015. The interconnection between interpretivist paradigm and qualitative methods in education. *American Journal of Educational Science*, 1(2):24-27.

The Central Bank of Jordan. 2019. *Central banks of Jordan unveil its support to the financial technology sector*. [Online]. Available at: https://www.cbj.gov.jo/DetailsPage/CBJEN/NewsDetails.aspx?ID=214 [Accessed: 17 October 2021].

The Institute of Chartered Accountants in England and Wales (ICAEW). 2024. *History of blockchain.* All coins news. [Online]. Available at: https://www.icaew.com/technical/technology/blockchain-and-cryptoassets/blockchain-articles/what-is-blockchain/history [Accessed: 20 October 2024].

Themistocleous, M., Christodoulou, K., Iosif, E., Louca, S. & Tseas, D. 2020. Blockchain in academia: Where do we stand and where do we go? *Proceedings of the 53rd Hawaii International Conference on System Sciences (HICSS)*, 5338-5347. http://hdl.handle.net/10125/64398

Thomas, G. 2017. *How to do your research project*. London: Sage.

Trochim, W.M.K. & Donnelly, J.P. 2016. *Research methods: The essential knowledge base*. Australia: Cengage.

Upadhyay, N. 2019. *UnBlock the blockchain*. Springer.

Vaismoradi, M. & Snelgrove, S. 2019. Theme in qualitative content analysis and thematic analysis. *Forum Qualitative Sozialforschung*, 20(3): Art. 23. doi.org/10.17169/fqs-20.3.3376

Valverde, S.C. & Fernandez, F.R. 2019. The future of blockchain in the European banking system. *Funcas SEFO*, 8(1):21-30.

VanderStoep, S.W. & Johnston, D.D. 2009. *Research methods for everyday life: Blending qualitative and quantitative approaches*. San Francisco: Jossey-Bass.

Vehovar, V., Toepoel, V., & Steinmetz, S. (2016). Non-probability sampling. In C. Wolf, D. Joye, T.W. Smith, & Y. Fu (eds.), *The Sage handbook of survey methodology*, 327-343. Sage. doi.org/10.4135/9781473957893.n22

Vergouwen, M.L.M. 2018. *Blockchain adoption in Netherlands: An explorative study into the factors that influence blockchain technology adoption*. Thesis, Nyenrode Business University, Netherlands.

Vijai, C. & Nivetha, P. 2020. ABC technology-artificial intelligence, blockchain technology, cloud technology for banking sector. *Advances In Management*, 13(4):19-24.

Wang, D., Zhao, J. & Wang, Y. 2020. A Survey on privacy protection of blockchain: The technology and application. *IEEE Access*, 108766-108781. doi.org/10.1109/ACCESS.2020.2994294

Wang, G., Wang, Q. and Chen, S., 2023. Exploring blockchains interoperability: A systematic survey. *ACM Computing Surveys*, *55*(13s), pp.1-38.

Wang, Y.M., Wang, Y.S. & Yang, Y.F. 2010. Understanding the determinants of RFID adoption in the manufacturing industry. *Technological Forecasting and Social Change*, 77(5):803-815. doi.org/10.1016/j.techfore.2010.03.006

Weber, W.E. 2016. *A bitcoin standard: Lessons from the gold standard*. Bank of Canada Staff Working Paper, 1701-9397. Ottawa: Bank of Canada.

Wongsuphasawat, K., Liu, Y. & Heer, J. 2019. Goals, process, and challenges of exploratory data analysis: An interview study. http://arxiv.org/abs/1911.00568

Xinping, Z. 2002. Interpretivist research, positivist research, and field research. *Chinese Education and Society*, 35(2):39-46. doi.org/10.2753/CED1061-1932350239

Yin, R.K. 2003. *Applications of case study research.* 2nd ed. California: Sage.

Yin, R.K. 2014. *Research design and methods*. 5th ed. California: Sage.

Zhang, Y. 2020. Developing cross-border blockchain financial transactions under the belt and road initiative. *The Chinese Journal of Comparative Law*, 8(1):143-176. doi.org/10.1093/cjcl/cxaa010

Zhao, C., Sun, J., Gong, Y., Li, Z. & Zhou, P. 2018. Research on the blue carbon trading market system under blockchain technology. *Energies*, 15(9):1-17. doi.org/10.3390/en15093134

Zheng, X. 2021. *Data collection in quantitative research.* In *Research methods for student*

radiographers. CRC, 79-92.

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. doi.org/10.1504/IJWGS.2018.095647

Zīle, K. & Strazdiņa, R. 2018. Blockchain use cases and their feasibility. *Applied Computer Systems*, 23(1):12-20. doi.org/10.2478/acss-2018-0002

Zivic, N., Ruland, C. & Ur-Rehman, O. 2019. Addressing byzantine fault tolerance in blockchain technology. In *2019 8th International Conference on Modeling Simulation and Applied Optimization (ICMSAO).* IEEE:1-5.

Zwitter, A. & Hazenberg, J. 2021. Cyberspace, blockchain, governance: How technology implies normative power and regulation. In B. Cappiello & G. Carullo (eds.), *Blockchain, law and governance*. Springer, 87-97.

APPENDIX A1: ETHICS DOCUMENT

Cape Peninsula University of Technology

P.O. Box 1906 • Bellville 7535 South Africa •Tel: +27 21 4603291 • Email: fbmsethics@cput.ac.za
Symphony Road Bellville 7535

Office of the Chairperson Research Ethics Committee	FACULTY: **BUSINESS AND MANAGEMENT SCIENCES**

The Faculty's Research Ethics Committee (FREC) on **20 October 2020**, ethics **Approval** was granted to **Mercia Theresa Abrahams (188026819)** for a research activity **Master of Business & Information Administration** at Cape Peninsula University of Technology.

Title of dissertation/thesis/project:	**Effect of Blockchain on Payment Services: A case of South African Commercial Bank** Lead Supervisor (s): Dr B Yan

Comments:

Decision: APPROVED

	**10 November 2020**
Signed: Chairperson: Research Ethics Committee	**Date**

APPENDIX A2: INVITATION LETTER TO PARTICIPATE IN THE RESEARCH

To: Abrahams, Mercia
Subject: RE: Mercia Abrahams - Blockchain Technology Thesis

Hi Mercia

Thanks and all the best to you too.
Send me a note on the specifics you need as a reminder so that I can get you access to the right people.

Kind regards
Manager

From: Abrahams, Mercia
Sent: Wednesday, 31 March 2021 20:00
To: xx
Subject: RE: Mercia Abrahams - Blockchain Technology Thesis

Evening Sir

Trust you well. First quarter of 2021 is gone with the wind. Wishing you the very best for the next three quarters.
The time has come for me to do my data collection. Please may I ask if I can make contact with you after the Easter weekend.
There has been a change and I'm hoping that you will still be able to assist. I am going to need to do virtual interviews as my research has changed to follow a qualitative approach, using an exploratory design to identify the effects of blockchain on payment services.

Thank you

Kind regards
Mercia

From: xx
Sent: 14 December 2020 08:24
To: Abrahams, Mercia
Subject: RE: Mercia Abrahams - Blockchain Technology Thesis

Hi Mercia

Well done and happy to be involved.

Kind regards

From: Abrahams, Mercia
Sent: Friday, 11 December 2020 15:51
To: xx
Subject: RE: Mercia Abrahams - Blockchain Technology Thesis

Dear Sir

Hope you doing ok. I'm sure you very busy wrapping up the year.
I am so sorry that I am only letting you know now. It's been so busy our end trying to get accounts opened and funds out of the country.
I was the happiest human being when varsity issued me with the attached approval notification.
I've asked my Supervisor if I can start early next year and he was ok with that.
Will it be okay with you if I make contact with you again early in the new year? You can let me know when you back from leave.

Once again thank you for helping me.
I really appreciate it.

Kind regards
Mercia

From: xx
Sent: 15 September 2020 15:37
To: Abrahams, Mercia
Subject: Re: Mercia Abrahams - Blockchain Technology Thesis

Hi Mercia
Happy with that.

From: Abrahams, Mercia
Sent: Tuesday, September 15, 2020 2:45:22 PM
To: xx
Subject: RE: Mercia Abrahams - Blockchain Technology Thesis

Good Afternoon Sir

Hope you are doing ok.
With regards to my thesis, the varsity has asked if it would at all be possible for me to make contact with at least 15 other people within the organisation in order for me to gather sufficient data.
I do not need to interview them, the Dr said that I can send a questionnaire instead which I will first share with you.
Hoping this will be possible.

Thank you

From: xx
Sent: 17 July 2020 15:21
To: Abrahams, Mercia
Subject: RE: Mercia Abrahams - Blockchain Technology Thesis

Pleasure Mercia and look forward to our chat.

Kind regards

From: Abrahams, Mercia
Sent: Friday, 17 July 2020 14:49
To: xx
Subject: Mercia Abrahams - Blockchain Technology Thesis

Dear Sir

Hope you doing well.
My name is Mercia Abrahams.
I would like to say thank you from the bottom of my heart, for your consideration to help me with my research.
My reporting line, has played a pivotal role in my academic success but I honestly did not think that he would know the subject-matter expert for this topic.
So I am over-joyed and I appreciate this more than you'll ever know because I was about to de-register since I've been battling soo much.
I will make contact with you early next week as varsity requires a consent letter which I will forward on to you.
I have to submit a proposal together with the consent letter from and only once my proposal is approved, will I then make contact with you re interview etc.
If all goes well for me, my field work will commence September/October.

Context re Topic

Title: Effect of Blockchain on International Payment Services: A case of a Commercial Bank in South Africa

Research questions:
1. What are the challenges or risks of applying blockchain technology in the South African Banking Industry?

2. What are the effects of blockchain on the following categories?
- Quality of System,
- Quality of Service,
- Quality of Information,
- Perceivable usefulness,
- Convenient usefulness, and
- Social influence.

Could the possible challenges or risks of applying blockchain technology be?
- Scalability
- Energy Consumption
- Currency stability
- Legislations and regulations
- Governance
- Costs
- Security
- Interoperability

Once again, many thanks.

Enjoy the weekend.

Kind regards

APPENDIX A3: LETTER OF INFORMED RESEARCH CONSENT

To whom it may concern

MERCIA ABRAHAMS – BLOCKCHAIN TECHNOLOGY THESIS

I Richard de Roos, in my capacity as Head, Foreign Exchange at Standard Bank, Corporate and Investment Banking, Global Markets give consent in principle to allow Mercia Abrahams, a student at the Cape Peninsula University of Technology (CPUT), to collect data in this company as part of his/her Master of Technology research. The student has explained to me the nature of his/her research and the nature of the data to be collected.

This consent in no way commits any individual staff member to participate in the research, and it is expected that the student will get explicit consent from any participants. I reserve the right to withdraw this permission at some future time.

In addition, the company's name may or may not be used as indicated below. (Tick as appropriate).

	Thesis	Conference paper	Journal article	Research poster
Yes				
No	✓	✓	✓	✓

APPENDIX B: INTERVIEW SCHEDULE

INTERVIEW QUESTIONS

1. **With the world going cashless, faceless, paperless, etc. most organisations are preparing for it with the use of technology.**

   a) The Bank has made advancements and investments in their digital capabilities; hence it is evident that it is open to exploring new technology.

   Since blockchain technology (BCT) is relatively new +- 13 years, when did the Bank consider to explore/adopt/start using it?

   Comment:

   b) Does the organisation have a clear technology strategy in place? If yes, how does it align with the organisational strategy and culture of the Bank?

   Comment:

   c) What were the motivating factors that encouraged the exploration/ adoption/use of the technology?

   Comment:

2. **With regard to the challenges of applying blockchain technology in the South African banking industry**

   a) What are the main challenges of adopting BCT for payment services in the Bank?

   Comment:

   How do you plan on overcoming these challenges?

   Comment:

   b) South African legislation and banking governance is very strict in terms of data privacy and security. How can blockchain technology strengthen data privacy in financial transactions?

   Comment:

   c) With the challenge of interoperability, how does the Bank apply protocol to enable blockchain economies to operate outside silos, and transfer files between each other?

   Comment:

   d) What type of risks could the Bank encounter by transitioning to BCT?

   Comment:

   e) How does blockchain impact the integration of legacy architecture and new business models?

   Comment:

   f) How does BCT assimilate into the current technology stack?

   Comment:

   g) How would BCT onboard historical transactional (analogue) data and merge it with current data?

Example: Payment history of a Mortgage Bond account that is 15 years old with 5 more years of payments to be made.

Comment:

h) Blockchain has an environmental cost. In terms of taking the environment into consideration, how does the Bank overcome the issue of consuming high amounts of energy?

Comment:

i) With regard to organisational resources, i.e. IT staff and banking Staff:

Does the Bank have sufficient technical expertise to manage BCT?

Comment:

Would the use of BCT reduce/increase your IT staff compliment?

Comment:

Would BCT require other banking personnel like myself (Sales Administrator) to undergo a steep learning curve?

Comment

j) 'Change' is a crucial component of growth and evolution. However, change inevitably also poses challenges.

What obstacles are management being faced with in respect of changing to BCT?

Comment

3. With regard to benefits of blockchain on payment services in the banking sector:

a) Payment services is an income generator to the Bank. In which way can blockchain add more value to enhance income generation?

Comment:

b) How does blockchain reduce cost for the Bank in effecting payments in respect of P2P?

Comment:

International payments and cross-currency payments

Comment:

Keeping records of transactions

Comment:

c) Would the use of blockchain give the organisation a competitive advantage in the financial sector? If yes, in which way?

Comment:

d) How would blockchain overall be a value-add to both the organisation and your client-base?

Comment:

4. With regard to the implication of blockchain technology on payment services at a South African Commercial Bank?

a) What are the difficulties experienced when executing payment services?

Comment:

b) What are the risks for the Bank when performing payment services?

Comment:

c) The time delay in cross-border and cross-currency payments is still challenging. How can blockchain make payment services more seamless?

Comment:

d) In which way will human error be less/or more if blockchain is applied to payment services?

Comment:

e) How does blockchain prevent fraud in doing payments?

Comment:

f) In traditional banking, the services of intermediaries e.g. SWIFT are required, how does blockchain change the dynamics of intermediaries?

Comment:

g) The Bank effects monthly payments, for example to SARS. If the Bank utilises blockchain, must SARS also be BC enabled?

Comment:

h) Is cybercrime a concern in respect of Blockchain?

Comment:

i) What would be the back-up plan, should there be a system-wide blockchain financial collapse or fail?

Comment:

Thank you for your time and patience in answering the questions. Your contribution is highly appreciated.

APPENDIX C: INTERVIEW RESPONSES FROM RESPONDENTS

With the world going cashless, faceless, paperless etc, most organisations are preparing for it with the use of technology.

RQ1(A) The Bank has made advancements and investments in their digital capabilities hence it is evident that it is open to exploring new technology. Since Blockchain Technology (BCT) is relatively new +-13 years, when did the Bank consider to explore/adopt/start using it?

P1 'Around 2017/2018 things started getting very interesting. From one to two people getting involved with blockchain, more staff, about ten members from various areas of the Bank showed interest and started to understand that the technology was going to have an effect on the business in one way or the other'

P3 'From 2018 to 2019 there was a bit more focus on blockchain specifically with our partners ICBC (Industrial and Commercial Bank of China) you know in terms of finding or solving for some specific use cases and then from 2019 onwards there was definitely a focus you know the team started building specific use cases around payments and letters of credit in the Bank and it's matured over the last two years, I mean to the extent where it's now live and it's in production and you know there's one or two clients using it'

P6 'This was mainly exploratory though and I'd say 2018 is when serious considerations started being contemplated, coinciding with the likes of project Khokha'

P7 'Been involved (and experimenting with) Blockchain as far back as 2017 (possibly even further), with our involvement in project Khokha, a Proof Of Concept (POC) to see if a distributed Ledger can replicate interbank clearing and settlement at a higher speed and quality'

Finding 1: The Bank started exploring BCT about seven years ago around payments and letters of credit.

Finding 2: About five years ago BCT has gone live in certain areas of the banking operation.

RQ2(B1) Does the organisation have a clear technology strategy in place? If yes, how does it align with the organisation strategy and culture of the Bank?

P1 'In my opinion, it does not exist, neither does a technology strategy exist in architecture'

P2 'It has a clear vision of its digital future but the technology strategy is not necessarily in place'

P3 'So it is on the top of mind in a lot of spaces but there's no clear driver to say that as part of technology or our technology landscape in the Bank blockchain must now be one of the things that you look at and I think that will mature in the coming years'

On the contrary, the following participants advised:

P6 'The Bank has a serious strategy in place which is primarily underpinned by leveraging big tech, fintechs, building and partnering'

P9 'Yes, we do, and it's been one that's evolved because I think you know blockchain being a relatively new field. we've learned a lot, and that was part of the objective for getting involved quite early'

P13 'Innovation is very much on the radar but specifically for Blockchain, so I think that the Group as a general has sort of a strategy in place around digitisation and Blockchain. Blockchain is probably the best technology and capability to really enable the Bank to fulfil its goals. Blockchain fundamentally is the technology set that can propel the Bank into a new world of technology where interfaces and legacy systems and challenges can be alleviated through a new refreshed modern technology without having to spend billions of rands and years of efforts. It can be achieved quite easily and seamlessly in many ways parallel to the existing business world'

Finding 3: Whilst the Bank has an organisational strategy in place, some participants felt that there is no clear technology strategy in place.

Finding 4: Other participants argued that there is a technology strategy in place due to the changing landscape of technology.

Finding 5: There is definite innovation and technological boundary-pushing to enable future readiness through technology implementation to ensure inclusive and sustainable technological advancement within the Bank.

RQ1(C) What were the motivating factors that encouraged the exploration/adoption/use of the technology?

P1 'The driving factor that motivated our team was to learn new things. Make sure that we change the business model and the reason I mentioned that point is because it ties into motivation. By exploring the technology, there could be a possibility for change. We took the opportunity to learn with the thought of influencing the business to take a closer look at the technology if it could bring about a change'

P3 'The use case for blockchain is very prominent in the terms of digitisation of documentation specifically because our products work across multiple banks as payments do'

P5 'Greater knowledge and understanding in the market. The possibility for faster settling of transactions. Better system of recording transactions on a blockchain'

P6 'Not to get left behind. Being able to participate in new business models'

P7 'Weigh the risks for our business. Collaborate with players in the blockchain space. Explore different solutions'

P8 'It's the inevitable way of what we doing with regards to data'

P9 'Making sure that the Bank becomes future ready'

P10 'Understand how the wall of technology is changing. It's also the element of the disruption that blockchain can cause in the financial sector that peaked curiosity. It has huge potential which is another reason why the Bank is exploring the technology'

P12 'To be seen as a bank that is always pushing the boundaries'

P13 'The biggest driver behind it was probably becoming aware of crypto and whats happening with the likes of bitcoin'

P14 'Bitcoin actually did'

P15 'Business logic encoded into smart contracts make blockchain the choice for banks for most of the projects'

P16 'Since we're just talking specific to payments here was essentially the functionality that blockchain provides. In payments you talk about cutting down intermediaries'

Participants that mentioned <u>cost efficiency as a reason:</u>

P2 'Cost'

P5 'Lower cost'

P6 'Cost'

P12 'Grow revenue'

P15 'And as a result reduction in the costs associated with the back office processing. Be it a digital payments process or it may be or it may be any process as well'

P16 'Bring down transaction costs'

Participants that mentioned <u>transparency as a reason</u>:

P6 'Transparency'

P8 'There's a trust and a transparency factor. It's about building a pillar of trust'

P11 'First and foremost it's one single Source of Truth, One Ledger, I believe this was the main driver, why they looked at blockchain'

Finding 6: The motivating factors that encouraged the exploration of the technology was to learn new

things so that the Bank has an understanding of how the wall of technology is changing and not get left behind.

Finding 7: The use of BCT has the potential to change the business model and business performance.

Finding 8: The use of BCT in respect of payment services definitely improves the Bank's bottom line by decreasing costs and improving efficiencies.

Finding 9: It is important for the Bank to be aware of what the market could possibly be aware of.

With regard to the implication of BCT on payment services at a South African Commercial Bank.

RQ2(A) What are the main challenges of adopting BCT for payment services in the Bank?

This question was asked to understand if there were specific challenges that the Bank was faced with, in its journey to adopting BCT in the payment services environment.

Ps 1, 3, 6, 7, 8, 9, 12, 13, 14, 15 made reference to Compliance, Governance and Regulation.

P3 'The right regulatory reporting infrastructure can make things better and easier'

P6 'The regulatory environment is still highly uncertain'

P8 'Getting regulatory boards to get rid of their old ways of doing things and really embrace new technology'

P12 'Regulatory laws and rules that becoming more and more complicated each year'

P15 'Still need to comply with all the regulatory aspects is the biggest challenge'

Ps 1 made reference to Acceptance of the Technology

P1 'Fear of the unknown, fear of the negative'

P12 and 16 made reference to Change Management

P12 'Change of Mindset to break away from the norm, of how things were done before'

P16 'Banks waiting for news of big implementations but not being the first player to do it - still want to wait and watch'

Ps 4, 6, 7 made reference to Technology Evolvement

P4' 'The level of technology is probably relatively immature'

P6 'The technology is still very early stage'

P7 'Integrating new technologies becomes quite a challenge when trying to work with newer technologies'

P11, P15 and 16 made reference to Technology and Innovation as well as Innovation Management

P11 'Lack of understanding from a technical perspective and Lack of understanding from a business perspective'

P15 'Existing payments infrastructure are extremely complex within most banks because these are decades old infrastructure and you know legacy systems'

P16 'Legacy technology'

P12 made reference to Collaboration

P12 'Blockchain in essence and by nature is a team sport. It doesn't help to introduce blockchain

just for one entity. Bank needs partners who will participate in blockchain network'

P15 made reference to cost factor

P15 'To implement disruptive technology at scale for production level is not very easy in terms of costs'

Finding 10: Compliance, Governance and Regulation from a South African perspective as well as from a global perspective is a huge challenge in the adoption of BCT in payment services.

Finding 11: The acceptance of BCT to certain levels of management is challenging due to fear of the negative aspects around the technology, especially crypto-currencies.

Finding 12: The Bank seems fearful of exploring and would rather wait for others to test the BCT technology.

Finding 13: Between the technical and business teams, there appears to be insufficient awareness of the benefits blockchain technology can bring to the business.

Finding 14: The current payments infrastructure is based on decades-old technology which is complicated and challenging to merge with newer technology.

Finding 15: Partnership with other entities is lacking which is preventing the organisation to accelerate innovation and the delivery of powerful digital services that BCT offers.

Finding 16: Implementation at scale of production level is very costly.

RQ2(A1) How do you plan on overcoming these challenges?

Ps 3, 5, 6, 13, 15 made reference to compliance governance and regulation.

P3 'The right regulatory reporting infrastructure can make things better and easier'

P5 'Working as closely with regulators as possible, from many different countries and institutions and being ready to implement these solutions once the greenlight is received'

P6 'Stay close to regulators and lobby'

P13 'Work with and engage with regulators to ensure we're building the controls and levels of comfort so that the visibility and honouring of the laws of the country is still in place'

P15 'Rigorous sort of evaluations on the blockchain technology on the product that you're about to use whether it meets up internal as well as external regulatory requirements'

Ps 9, 11, 12 made reference to Collaboration

P9 'Right from the outset, you need to be very focused on identifying partners'

P11 'It doesn't help to introduce blockchain just for one entity. Bank needs partners who will participate in blockchain network like Stanbic, Nigeria, Kenya etc'

P12 'Working with like- minded companies to connect and expand the eco-system'

P7 made reference to Organisational Culture Change

P7 'Require a change in culture; change in our thinking'

P8 and 9 made reference to Technology Adoption

P8 'Embrace new technology like a blockchain'

P9 'needing to invest in their experimentation'

Ps 6 and 9 made reference to Market Intelligence

P6 'Education both internal and to the public'

P9 ‘Broader participation in the market’

Finding 17: It is important to the Bank to establish control systems and levels of comfort with regulators to ensure visibility and to ensure and that respect for the laws of the country as well as other countries are not compromised in terms of compliance, governance and regulation.

Finding 18: Collaboration and building strong partnerships with other banks internationally is key to overcoming some of the challenges faced with in payment services.

Finding 19: Change in organisational culture, specifically change in thinking will help in solving some of the challenges.

Finding 20: Embracing BCT in payment services is still challenging and investing money in experimentation is slow.

Finding 21: It is important to the Bank to have market intelligence about what is happening in the existing market for competition and growth.

RQ2(B) South African legislation and banking governance is very strict in terms of data privacy and security. How can blockchain technology strengthen data privacy in financial transactions?

Ps 1, 5, 6, 8, 11, 14 made reference to using the process of cryptography to enable encryption

P1 ‘The data in the blockchain is encrypted’

P5 ‘Enforced with cryptography as well as other methods such as authorisation and authentication’

P6 ‘Encryption is baked into web 3.0 technologies and so privacy and security are one of the key parts of this industry and technology’

P8 ‘you’ve got to encrypt your own data’

P11 ‘Using cryptography, consensus is given every time when credentials is shared with another party’

P14 ‘That data, though it’s not visible, people make sure that they have some kind of encryption on top of it also’

Ps 11 and 14 made reference to SSI

P11 ‘Self sovereign identity (SSI). That’s the keyword’

P14 ‘Self sovereign identity (SSI), means the customer has control over the identity of the self

and blockchain actually ensures that identity is maintained by you’

Ps 1, 3, 12 made reference to private networks

P1 ‘We create a private network not a public network’

P3 ‘Secure networks or private networks that only selected participants can see the information’

P12 ‘There are also private and public block chains that can work together or separately’

On the contrary, P2 was not sure that blockchain technology could strengthen data privacy.

P2 ‘Not sure it can strengthen’

Ps 8, 11 argued that blockchain technology does not provide data privacy, whilst P13 alluded to the fact that data should not be private for monitoring purposes’

P8 ‘Blockchain doesn’t necessarily cater for privacy, it gives that control over to you who are the companies that are actually building the solutions itself’

P11 ‘Blockchain by design would be the complete opposite of data privacy’

P13 ‘I think the visibility of transactional data is something that should be open and visible to the world and people should be able to monitor flow of things through a network and be able to identify when certain things are happening’

Finding 22: BCT can strengthen data privacy in financial transactions by using the process of cryptography to enable encryption.

Finding 23: BCT can strengthen data privacy in financial transactions by using an identity management system called Self-Sovereign Identity.

Finding 24: BCT can strengthen data privacy in financial transactions by using private networks.

Finding 25: On the other hand, P2 was not sure the BCT could strengthen data privacy in financial transactions.

Finding 26: Ps 8, 11 argued that blockchain technology does not provide data privacy.

Finding 27: Whilst P13 alluded to the fact that data should not be private as it hinders the process of monitoring transactions.

RQ2(C) With the challenge of interoperability, how does the Bank apply protocol to enable blockchain economies to operate outside silos and transfer files between each other?

P1 ‘We built a unique API layer around our blockchain that allows us to integrate with and across silos with various systems channels using API’s. We create nodes that represent each of our bank entities and our branches across Africa’

P13 ‘There’s one trusted area of transaction and it could be multiple blockchains multiple ecosystems and they can be connected to almost work together so they still perceived as a single ecosystem where anybody can effectively communicate with each other and do business with each other and whatever the version of the truth at the at point is generally accepted without the need of having tedious reconciliations. To answer the protocols component of it in term so of a blockchain environment, it is supported by a consensus mechanism that drives the trust into what is considered the truth at any given time. No need for protocols, it’s a bit of a tricky construct’

P15 ‘There are some sort of solutions in the market one of them is algorithm which are blockchain protocols which promote interoperability’

P3 ‘Every business area is almost doing their own thing at the moment and there’s no architecture that brings everything together yet. The Bank’s not made a strategic decision yet’.

Finding 28: Eleven (11) participants felt that the Bank has a solution in place in terms of interoperability by using API’s and applying consensus mechanism for the different silos within the Bank to interact.

Finding 29: P3 felt that there is framework in place to unite the different silos.

RQ2(D) What type of risks could the Bank encounter by transitioning to BCT?

Ps 4, 9 and 11 felt that adopting any new type of technology is a risk in itself, whilst P13 argued that it is a mistake and a big risk to not adopt BCT.

P4 ‘I think the Bank will probably be unlikely to change until there is a kind of ground swell within the international industries. Trying to integrate a brand new type of technology into existing platforms or building an entire new payment architecture from scratch becomes quite a big investment and quite a big change which is a very risky thing to do’

P9 ‘Brand new technologies bring uncertainty, so it’s it’s untested in some cases’

P11 ‘With the the technology being immature, there are a lot of moving parts, which makes the technology in itself a risk’

P13 ‘I think the biggest risk for the Bank is to not adopt blockchain technology, the reality is that the world is going to move into a distributed ledger context within the next five to ten years and if the Bank if not part of the movement, chances are they would become irrelevant’

Ps 6, 8, 9, 10 and 14 made reference to compliance, governance and regulation.

P6 ‘Regulatory problems’

P8 ‘We’re not looking at it from South Africa or Africa, everything is global hence lack of engagement with government and regulation is a risk

P9 ‘Regulatory framework, is also a potential risk that we can run ahead of’

P10 ‘The biggest risk that I observed is compliance to personal information’

P14 ‘The information that gets embedded into a chain is there forever - legislation mandates that you can only retain it for five years. So I think there might be some compliance risks’

Finding 30: Any new technological adoption entails a certain measure of risk.

Finding 31: P13 argued that it is a mistake and a big risk to not transition to BCT.

Finding 32: Risks arises from pioneering ahead of national and international regulatory frameworks.

Finding 33: Current Compliance, Governance and Regulation is the opposite of what BCT offers in payment services in respect of data privacy and retention period of information.

RQ2(E) How does BCT impact the integration of legacy architecture and new business models?

Ps 1, 2, 8 and 9 felt there would be no impact.

P1 ‘By implementing the API layer it makes it easy for us to plug into an existing business model and we plug into an existing system’

P2 ‘It will hopefully complement through successful interoperability’

P8 ‘It’s automated with processes by API’s and all sorts of stuff’

P9 ‘You use things like API for example’

Ps 3, 5, and 7 felt that there would not be a need for integration.

P3 ‘Legacy tech will be rebuilt to work on the new tech to offer the new services and unlock new

business potential with that’

P5 ‘The new technology would ideally replace a lot of the legacy systems that exist’

P7 ‘The unique thing about blockchain technology is that, depending on the use case, it could wipe out entire processes and with it some existing legacy systems’

P13 on the other hand felt that integration was not a good idea.

P13 ‘Don’t think it’s a good idea to integrate blockchain into legacy architecture as it’s not suited to what blockchain is meant to achieve’

Finding 34: With the use of API’s, there would be no impact on the integration of legacy architecture and new business models.

Finding 35: With the use of BCT, there would not be a need for integration as it could cancel entire processes and expunge existing legacy systems.

Finding 36: P13 felt that integrating BCT into legacy architecture was not advisable as it does not align to the purpose of what BCT is meant to fulfil.

RQ2(F) How does BCT assimilate into the current technology stack?

P7: ‘Proof of Concepts and Early-stage projects, it is more likely that you will be integrating with existing tech rather than creating completely new solutions from scratch’

P14 ‘Blockchain or blockchain technology is very much API driven so it can be assimilated like

any other system installation. It is integrated through API's. it is the modern design language'

P6 'Building the infrastructure from the ground up completely independently of legacy and not trying to tie them together would be the way I would go to avoid banking in old ways'

P15 'Most of the legacy systems may not be API enabled that is where we may have to bring in new technologies to aid in with the blockchain

Finding 37: There appears to be a difference of opinion as some participants felt that assimilation into the current technology stack can be achieved through pilot projects and the use of APIs whilst others felt that legacy systems should not be integrated but that brand new architecture should be introduced to avoid going back to the old way of working.

RQ2(G) How does BCT onboard historical transactional (analogue) data and merge it with current data?

Example: Payment history of a Mortgage Bond account that is 15 years old with 5 more years of payments to be made.

P6 'Recreate these transactions anew in the new infrastructure'

P7 'Historical data will most likely be migrated where feasible, and in specific cases, where not necessary, there will be a 'closing out' period'

P13 'As a bank we have requirement to hold information for five years. We will have to maintain that compliance at the time that we switch to blockchain by keeping the existing databases and existing information in the legacy construct for five years'

P15 'I would not think that blockchain would need to onboard a lot of historical data because blockchain itself is a database but it doesn't make sense to onboard historical data from a current database onto a blockchain-based database one it would be too costly and secondly blockchain would need to store only the relevant data into its database'

P16 'You don't actually migrate anything onto the blockchain solution per se, so you have that in your off chain database but onto the chain you only start with the new data that is being generated'

Finding 38: There was a general feeling that historical data would be transferred to the new technology.

Finding 39: P12 stated that the Bank has to comply with legislation to hold information for five years and for this reason, the existing databases will need to be held for five years.

Finding 40: Two participants disagreed that historical data should be onboarded on a blockchain, instead it should be stored off-chain.

RQ2(H) Blockchain has an environmental cost. In terms of taking the environment into consideration, how does the Bank overcome the issue of consuming high amounts energy?

P7 'Blockchain, and more specifically, its use with respect to cryptocurrency has proven to have a significant impact on the environment'

P10 'I don't think that carbon footprint is understood by the industry as a whole but this particular bank is very involved in environmental projects. The Bank is not mining therefore they are not consuming high amounts of energy'

P11 'If the Bank managers to decommission legacy systems, which requires more servers or infrastructure and uses blockchain, then blockchain actually makes it greener'

P13 'We actually in a process of establishing a node once we have regulatory approval to start mining. But it is a carbon neutral ecosystem so the algorithm and technology used is not the same that Bitcoin uses for consensus'

P15 'In fact we have newer versions of Hyperledger which are the most used versions of private blockchains plus other versions like Ethereum which are actively promoting throughput at lower cost and therefore the environmental damage we expect would be much much much lesser than mining'

Finding 41: The general feeling of the participants was that the Bank is very conscious of their carbon footprint, hence their use of BCT would not have a negative effect on the environment, especially

because there is no need for mining in the banking industry.

Finding 42: P11 alluded to the fact that the Bank would contribute to a healthier environment by discontinuing legacy architecture and replacing it with BCT.

RQ2(I1) With regard to organisational resources i.e. IT Staff and Banking Staff, does the Bank have sufficient technical expertise to manage BCT?

Thirteen out of sixteen Participants answered this question and all of them advised that there are not enough experts within the Bank to manage BCT.

Finding 43: There are not enough experts within the Bank to manage BCT.

RQ2(I2): Would the use of BCT technology reduce/increase your IT staff compliment?

Six (6) participants did not respond.

Three (3) participants felt it would increase the staff compliment.

Three (3) participants felt it would decrease the staff compliment.

Two (2) participants felt it would initially increase and thereafter there will be a decrease.

Two (2) participants felt that the staff compliment will remain constant.

Finding 44: The information received is conflicting in that some participants felt that the adoption of BCT would decrease staff, whilst others felt it would create a need for more staff. Contrarily, others felt it would not have any effect on staff compliment. Furthermore, others felt it would initially cause an increase and thereafter a decrease.

RQ2(I3) Would BCT require other banking personnel like myself to undergo a steep learning curve?

Four (4) participants did not respond.

Six (6) participants felt that it would be necessary for other staff to be upskilled in their respective divisions.

Six (6) participants felt that it would not be necessary for other staff to be upskilled in their respective divisions

Finding 45: Information received in respect of the broader staff compliment being upskilled in respect of BCT was clashing as half felt that is was a necessity and the other half felt it was non-essential.

RQ2(J) Change is a crucial component of growth and evolution. However, change inevitably also poses challenges. What obstacles are management being faced with in respect of changing to BCT?

P2 ‘Mostly finding the capital resources to sandbox ancient technologies’

P4 ‘Difficult to find individuals who have that experience and the skill set to support you particularly in the payments environment’

P5 ‘Legacy systems, integrating with these and managing these systems is difficult; Silos/barriers between teams’

P5 ‘Regulation – constantly uncertain of the way forward’

P10 ‘Management needs to be strategic’

P13 ‘There are people who just want to go back to years ago and want to continue living in that space however stupid it is’

P14 ‘I think we keep on battling peoples perception when it comes to blockchain because people think blockchain means cryptocurrencies’

Finding 46: There is a lack of financial resources to sandbox legacy technology.

Finding 47: There is a shortage of BCT skills set particularly in the payments environment.

Finding 48: Teams within the Bank are not open to collaboration to integrate the legacy systems.

Finding 49: Regulation is an ongoing challenge as there is no clear way of managing BCT going forward.

Finding 50: Management does not have strategy in place to embrace BCT.

Finding 51: Employees are resistant to change due to lack of clarity and reasons for the change.

Finding 52: The educational piece is lacking hence employees do not have a clear understanding of BCT.

With regard to benefits of BCT on payment services in the banking sector:

RQ3(A) Payment services is an income generator to the Bank. In which way can BCT add more value to enhance income generation?

P6 'Potentially new services and revenue lines e.g. collateral transformation, tokenised asset management, digital asset custody, digital asset loans and deposits, new forms of settlement etc'

P7 'Through providing cheaper transaction costs'

P8 'So bigger customer relationships means they are using more of your services and using them more effectively so ultimately it leads to an income generator for the Bank'

P14 'Infrastructure savings can be big because you decentralising the payments'

P16 'With blockchain all those systems in between and processes that are for reconciliation and for doing your audits goes away and costs will be reduced significantly'

Finding 53: BCT can generate revenue for the Bank through potentially new products or services e.g., digital asset custody, digital asset loans and deposits.

Finding 54: With the use of BCT, services could be more effective, which could lead to client expansion, which, in turn, could stimulate revenue growth.

Finding 55: BCT optimises the management of infrastructure, which reduces costs significantly as payment services are maintained and controlled by a centralised single entity.

Finding 56: BCT effectively automates portions of audit processes, which reduces the cost of monitoring since the accuracy of all transactions in the information systems will be time-stamped with real-time audits trails.

RQ3(B1) How does BCT reduce cost for the Bank in effecting payments in respect of P2P

P4 'The cost of the tech itself is cheaper, faster, and requires less human oversight than legacy payment systems'

P12 'The cost of actually doing business for the Bank is somewhere around a billion rand a year now in payments context to support the network and IT infrastructure and everything to make that happen so from a blockchain perspective we can reduce those costs to close to zero'

P13 'The processing time of for the payment is going to be reduced'

P15 'On the blockchain-based payments there are some protocols like ripple which are focusing on peer-to-peer payments and institutional payments that's going to reduce a lot of the Banking related costs'

Finding 57: BCT reduces cost in P2P payments as less human oversight is required.

Finding 58: P2P payments require costly network and IT infrastructure support, which, with the use of BCT, can be reduced significantly.

Finding 59: Processing time for P2P payments will be reduced, which ultimately reduces banking costs.

RQ3(B2) How does BCT reduce cost for the Bank in effecting payments in respect of international payments and cross-currency payments?

P1 'Operations and validation also can be reduced by virtue of us using smart contracts to automate some of those services. We're doing that already'

P2 'Reduces the need for third party correspondent banking systems and SWIFT'

P7 'Introducing these new cloud-based solutions, hosted on a blockchain network, where hardware and software resources are spread out between every node on the network means we reduce our costs to create a payment significantly meaning we're able to explore different pricing models'

Finding 60: BCT reduces the need for third party correspondent banking systems and SWIFT in cross-border payments by using smart contracts that reduces costs and subsequently enable exploration of different pricing models for clients.

RQ3(B3) How can BCT reduce cost for the Bank in effecting payments in respect of keeping records of transactions?

P2 'Real time cloud-based records'

P5 'Recording of transactions is done automatically through the Hyperledger and the introduction of new blocks to the blockchain'

Finding 61: BCT has the potential to impact all record-keeping processes, including the way transactions are initiated, processed, authorised, recorded and reported.

RQ3(C1) Would BCT give the organisation a competitive advantage in the financial sector?

P1 'Absolutely! If we do it right'

P15 'Yes it would It depends on where you are in this blockchain journey'

Finding 62: The Bank believes that adopting BCT will give the organisation a competitive advantage

RQ3(C2) If yes, in which way?

P1 'By coupling low-cost transaction fee or even zero fee, self-service tracking and a good user interface for clients, we can take a large chunk of the market'

P7 'The transparency and immutable nature of the technology allows for opportunities to explore new improvements and features to our customers and improve their overall experience'

P9 'The value lies in the sharing between multiple parties'

P13 'The concept around blockchain and distributed ledger is around creating ecosystem and a financial world that is inclusive and supportive of everybody to create a better world'

P13 'It's not about winning or losing, it's about creating partnerships'

Finding 63: Early adoption of the technology can give the Bank a competitive advantage by optimising on transaction costs, thereby strengthening its place in the market.

Finding 64: Competitive advantage to the Bank does not necessarily mean being better than others, but rather fostering strategic alliances, thereby creating collaborative advantage, which can be utilised for the fuller value-creating potential of the broader ecosystems wherein they operate.

RQ3(D) How would BCT overall be a value-add to both the organisation and your client-base?

P1 **'**Efficiency and cross sell'

P7 'Exposure to more businesses in the form of importers/exporters, buyers/sellers, businesses'

P13 'This new blockchain and distributed ledger environment that is being developing and being created across the world is a collaborative thing. A collaborative world is being created'

P15 'Banks can create their own closed loop ecosystems which basically means that they can

define who are the sort of participants in the process and establish a payment network within that process itself and run their own network at a fraction of the cost through the use of the blockchain technology which would be the competitive advantages that the banks would get'

Finding 65: BCT can maintain digital integration between customers and partners.

Finding 66: BCT can unlock the gate to establish an autonomous open and scalable payment network system, providing operational efficiency and performance excellence.

With regard to the implication of BCT on payment services at a South African Commercial Bank.

RQ4(A) What are the difficulties experienced when executing payment services?

P1 'Reporting to the regulator'

P9 'There are many different regulators if you talking about cross-border payment that has to be taken into account'

P12 'It won't actually be allowed to go into a production environment without regulation and approval'

P13 'There is the absence of regulations to govern how these instruments/digital assets should be managed and used as payment mechanisms'

P2 'Various legacy systems and external validations'

P3 'The actual processing of payments are still done on our core banking system'

P5 'Integrating with existing systems, marketing to clients'

P8 'This application or this architecture we have in the Bank called EE (Enterprise xxx) It sounds like a something out of a star trek movie. Basically this architecture is the problem. it's goes through these steps of approval within the Bank. Some of these steps are manual based - it's people actually physically pulling the data out, looking at certain fields comparing them based on data they get from maybe other divisions within the Bank and then they click 'approve' to send it on to the next level and that's really where the delay process is taking place. it forces all this this payments stuff that we have that's happening in the Bank to go into kind of like a batch process and it has to kind of filter in one by one by one. If that is wiped out and the trust is put into the blockchain technology then basically what it does, is you're getting instantaneous trust traceability and transparency'

P10 'Where there are many small transactions. This creates high volume and this causes strain on the infrastructure or on the IT systems'

P15 'To bring in a blockchain technology at scale to an extremely complex and established network and to change the heartbeat of the system as such is going to be a challenge'

P8 'People don't understand blockchain in its entirety and what benefit it can bring to the organisation; The Bank has to modernise, it has to move forward into the future it cannot stay doing the same thing that it's currently doing forever else it will die'

P9 'To integrate blockchain into the mainstream financial network and payments systems across the world is not trivial. That is a big piece of work'

P14 'Partnerships are very important when it comes to a payment network. The biggest challenge is people agreeing to come onto the network'

P6 'Lack of speed'

P10 'as well as downtime'

P16 'Scaling issues; Throughput management'

P1 'Wrong beneficiary details especially with cross-border payments'

P10 ‘Authorisations and levels of authority’

P12 ‘There’s also a back end of due diligence that needs to be done’

Finding 67: The difficulty in executing payment services lies in the fact that regulators globally are finding it difficult to structure a clear framework to govern BCT, which is designed to be self-regulating and self-maintaining. This is prohibiting the Bank from gravitating to an innovative approach to launch successful initiatives as they currently are compelled to take on a risk-averse approach.

Finding 68: Legacy systems for payment services were developed many years ago, which currently lack the ability to keep up with modern technologies. Modern payment solutions help to scale a business, but as a result of the Bank being at the core of their overall banking architecture, making changes to their systems would affect daily operations. However, the delay in making changes ultimately hinders business growth.

Finding 69: Inertia (persistence to use incumbent systems whilst there are better alternatives), appears to be applicable not only to individuals, but also to organisations.

Finding 70: The formation of collaborative innovation partnerships to build an effect payment network is challenging.

Finding 71: Traditional payment systems pose challenges such as lack of speed, downtime, scaling issues, throughput management and wrong beneficiary details, especially with cross-border payments.

Finding 72: Internal processes to effect payment services are long-winded.

RQ4(B) What are the risks for the Bank when performing payment services?

The following Ps answered this question in terms of risks using traditional methods of executing payment services:

P2 ‘Fragmented client experience’

P5 ‘Vulnerability to being hacked’

P6 ‘Vulnerability to being hacked; Lost payments’

The following participants answered this question in terms of risks using BCT when executing payment services:

P1 ‘Risk is reduced significantly to almost nothing provided that all the necessary checks are done’

P5 ‘P2P transactions between wallets is risky’

P12 ‘Blockchain uses smart contract consensus, so the rules that are implemented doesn’t allow for cheating’

P12 ‘No disputes cause the ledger is visible to everyone and there is only one version of the truth, so I would say that risks will be reduced’

P12 ‘Payments won’t get lost’

P13 ‘If somebody somehow manages to scam a person of his account details and manages to do illegal payment to an unauthorised account, reality is that the underlying cash is still within central banks control and effectively it can be reversed and the criminal party in a construct cannot get access to that asset’

P14 ‘I don’t think bank has any other any additional risks’

Finding 73: Risks to the Bank using traditional technology in executing payment services include poor client experience in terms of payments that could get lost and client accounts that could get hacked, resulting in customer liability.

Finding 74: Risks to the Bank using BCT in executing payment services is significantly reduced in that fraud is mitigated and operational interruptions are low because BCT develops smart contracts that induce the capability of visible and safe financial transactions.

RQ4(C) The time delay in cross-border and cross-currency payments is still challenging. How can BCT make payment services more seamless?

P1 'We are looking at creating a wallet structure. Wallets basically will represent some sort of a bank account and if you've got a representation of a value in your wallet, then on the blockchain, you can pass it to the recipient on the same structure you can get immediate settlement'

P2 'Real time validation and settlement'

P3 'Putting a blockchain solution in place might not necessarily make it quicker it might make it more transparent'

P5 'The use of blockchain will significantly speed-up settlement times. Provided all information is correct, the speed of the transactions should be a few hours at most, for verification and validation of transactions on the blockchain'

P6 'Near real-time international settlement is completely novel'

P10 'With blockchain it is real-time'

P12 'Real time reporting for auditing firms. To enable them to have a copy as well of the types of transactions that are processed. Currently, they look at auditing once or twice a year'

P12 'Automate due diligence for existing clients to speed the cross-border payment process'

P14 'Spot rates requires reconciliation but if done through blockchain it is immediate and the transaction is done'

P15 'Then there are some solutions supported over blockchain like stable coin solutions that will enable certain inbuilt security features to pave the way for blockchain to be integrated for cross border be it payments, be it remittances, be it you inter-entity payments '

Finding 75: Traditional cross-border payments involve a variety of disparate systems, which results in high transactions fees and delayed processing times. As economies are globalising and digitalising, BCT offers cross-border payments the benefits of speed, near real-time clearing and access to new markets.

Finding 76: P3 alluded that BCT may not necessarily speed up cross-border payments, but it would offer transparency throughout the cross-border payment process.

RQ4(D) In which way will human error be less/more if BCT is applied to payment services?

12 out of the 16 Participants answered this question. With the exception of P1, the rest believed that human error will be less.

P1 'Blockchain will not make more or less human errors. Reality is that it is human to make mistakes. If you lose your bitcoin wallet address, your password and your keys you're done…. it's gone!'

Finding 77: Twelve (12) of the 16 participants believed that human error will be less if BCT is applied to payment services as both automation and artificial intelligence can be used to improve productivity, reduce time and cost associated with manual verification, and provide a seamless payments service offering.

RQ4(E) How does BCT prevent fraud in doing payments?

P1 'Reporting by blockchain provides accurate information to Compliance Bodies or Regulators as it can identity trends, identify people, identify times which can help combat fraud'

P2 'Shared ledger'

P3 'But if you link the blockchain solution with fraud prevention tools or pro fraud checking tools the combination of the two will strengthen that process'

P5 'Ensuring that transactions are not suspicious using AI/ML, building failsafe's at each step of the process'

P8 'Because it's immutable, there's a way to trace back once it gets embedded on the actual

blockchain ledgers and these can be multiple ledgers; It's hard, actually impossible quite frankly to manipulate the data once it's passed in there; Immediately when it's passed in a specific state it's sealed and it's there forever you would have to bring down multiple servers as a hacker and by the time you do that you'll probably be caught and arrested; This is a technology of of trust and traceability'

P11 'Blockchain makes it very difficult because of the real-time factor'

P12 'We're working on something called self-sovereign identity (SSI). Creating a digital identity to make payments instead of using an account number. That's how blockchain can prevent identity fraud and fraudulent payments'

P4 'Reduce yes - Prevent no'

P6 'It doesn't necessarily do that, billions in USD of fraud are committed leveraging blockchain; The transparency makes fraud much more traceable though'

P9 'the transparency on the data and the one version of the truth will make it harder to falsify records therefore some types of fraudulent activity will be harder to perform than others'

P10 'With any technology, once it can be figured out, it can be used to practice fraudulent activities, but I think blockchain will create more visibility'

P14 'Fraud can't be prevented, but it can be reduced from the input'

P15 'Absolutely because of the real-time nature of blockchain using consensus with the relevant security of the participant will significantly reduce the fraud instances'

P16 'The minute you bring in things like consensus mechanism and encryption that blockchain has that automatically brings in that level of trust and reduces fraud'

Finding 78: Seven participants agreed that fraud can be prevented using BCT tools such as shared ledger, artificial intelligence and self-sovereign identity as well as applying the characteristics of BCT architecture, namely immutability and quick settlement.

Finding 79: Contrarily to finding 78, seven participants said that BCT cannot prevent fraud, but it can most definitely reduce it based on the characteristics of BCT architecture, which include transparency and a consensus algorithm.

RQ4(F) In traditional banking, the services of intermediaries e.g SWIFT are required. How does BCT change the dynamics of intermediaries?

P7 'There also exists the possibility to rule them out of the process completely. This is most likely how the future of payments will look'

P13 'Blockchain itself is the infrastructure to replace the use of SWIFT and the use of VisaCard and MasterCard to still provide financial services to the client'

P9 'Bear in mind that blockchain is not an organisation, it is a technology, so it could underpin the computing platform. Swift could adopt blockchain'

P12 'They do not want to be left behind hence them trying to get on board to get blockchains like Hyperledger'

Finding 80: The general feeling is that BCT can help to create a favourable environment where payments between parties—P2P, B2B—can deal with each other directly with minimal or zero involvement of the middleman namely SWIFT.

Finding 81: SWIFT (Society for Worldwide Interbank Financial Telecommunications) could very well explore and adopt BCT in their operation.

RQ4(G) The Bank effects monthly payments, for example to SARS. If the Bank utilises BCT, must SARS also be blockchain-enabled?

12 out of the 16 Participants responded to this question and 11 answered that SARS does not need to be blockchain-enabled.

However, P3 differed – 'Yes if they want to use that server'

Finding 82: Most participants responded that a partner, e.g., SARS, does not need to be blockchain-enabled to interact with the Bank

Finding 83: P3 differed and felt that partners need to be blockchain-enabled to have access to the server.

RQ4(H) Is cybercrime a concern in respect of Blockchain?

15 out of 16 participants answered this question.

13 felt that cybercrime is a concern with the exception of one participant.

P15 'No because blockchain basically enforces trust so it has got inbuilt algorithms which are evolving and getting more complex to break in to which would make it difficult for cyber criminals to attack it'

P16 'If you look at things like digital identity and self-sovereign identity, blockchain is being used to prevent such cybercrime from happening; It can also be used to prevent DNS (domain name service) attacks in your other website-based attacks so while there is an element of security that's already existing, blockchain is being used to prevent these cyber attacks'

Finding 84: Most participants felt that cybercrime is an ongoing concern in respect of BCT considering the lucrative nature of cybercrime and the ingenuity of criminals to plot attacks.

Finding 85: Two participants disagreed that cybercrime is a concern as the method of cryptography and the process of encryption make it difficult for cybercriminals to attack.

RQ4(J) What would be the back-up plan, should there be a system-wide blockchain financial collapse or fail?

Finding 86: All 16 participants advised that it is highly unlikely for all nodes in a blockchain network to fail simultaneously as blockchain networks are designed to be resilient. Whilst nodes are expected to go offline from time to time, the network can continue to function provided there are enough nodes to validate transactions and maintain a copy of the blockchain.

APPENDIX D: EDITOR'S CERTIFICATE

6 December 2024

MERCIA THERESA ABRAHAMS
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CERTIFICATE - EDITING OF MASTER'S THESIS

I, the undersigned, herewith confirm that the editing of the Master's thesis of **Mercia Theresa Abrahams**, titled, *"Effect of blockchain technology on payment services: A case of a South African Commercial Bank"* has been conducted and concluded.

The finalised thesis was submitted to Me. Abrahams on 6 December 2024.

Sincerely

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