UNIVERSITY *of the*
WESTERN CAPE

FACTORS AFFECTING THE ADOPTION OF BLOCKCHAIN IN LOGISTICS IN SOUTH AFRICA

NAME: SELAMAWIT MATHEWOS DAGNE

STUDENT NUMBER: 3984720

Plagiarism similarity index: 27

A mini-thesis submitted in fulfilment of the requirements for the degree of
MCom E-Logistics
In the Department of Information System
Faculty of Economics and Management Sciences
University of Western Cape

SUPERVISOR: Prof Osden Jokonya

DATE: JUNE 2023

DECLARATION

I, Selamawit Mathewos Dagne, hereby declare that “Factors affecting the adoption of blockchain in logistics in South Africa” is my original work and that all sources have been accurately reported and acknowledged, and that this document has not previously, in its entirety or in part, been submitted at any university in order to obtain an academic qualification.

Full name: Selamawit Mathewos Dagne Date: June 2023

Signature: 

Approved by

Prof Osden Jokonya
Supervisor

Signature:

ABSTRACT

This study aimed to explore the factors affecting the adoption of blockchain technology in logistics in South Africa. A quantitative research approach based on positivist philosophy was used to explore the phenomenon. An online survey was conducted with representatives of retail logistics organisations in South Africa. A convenient sampling method was used to gather participants for the survey. Eighty (80) questionnaires were distributed to these representatives, but only 60 participants participated in the study, representing a survey return rate of 75%. Data were analysed using Statistical Package for the Social Sciences (SPSS) to produce descriptive frequencies and other advanced statistical results from the collected data.

In the study, the blockchain adopted the Technology-Organisation-Environment (TOE) framework to analyse data from the study. The key findings from the study demonstrate certain organisational and technological factors that influence the adoption of blockchain. The key organisational factors are the structure of the organisation, management support and the availability of resources. The technological factors are perceived benefits, perceived compatibility, security and the availability of technology. Similar to technological factors, certain factors present in the environment of the organisation tend to influence its decision on whether or not to adopt blockchain technology. The critical factors are external support, competitive pressure and government regulations. Provided with these identifiers, appropriate recommendations are provided. This study adds to the body of research on factors affecting the adoption of the blockchain logistics industry. The limitation of the study is that the sample size may not entirely be representative of the logistics organisations in South Africa, as the researcher only received responses from willing organisations.

.

KEYWORDS : Blockchain; supply chains integrationtechnology adoption; supply chain digitisation; logistics integration

DEDICATION

I thank God Almighty for this opportunity, the direction and for answering my prayers. I dedicate this thesis to my parents for shaping me into the person I am today. Thank you for your unwavering love, advice, prayers and support, enabling me to succeed and instilling in me the belief that I am capable of accomplishing anything I set my mind to. To my husband, Temesgen Katiso, thank you for all your love, unshakeable support and encouragement and for being my anchor. I could not have done it without your never-ending patience and inspiration. Thank you very much.

ACKNOWLEDGEMENT

I hereby use this opportunity to express my profound gratitude to my supervisor, Prof. Osden Jokonya, for his diligence and guidance throughout this entire thesis. I truly appreciate it. My thanks also go to my uncle, Professor Mulugeta Dinbabo, who is lbig brother to me, and he is the one who encouraged me to enrol for this programme at UWC. I also want to thank my classmates, Hendry Thobela and Patrick Sello. Last but not least, my gratitude goes to Dr Kamara Richard Douglas for his moral support.

TABLE OF CONTENTS

Contents

LIST OF TABLES

LIST OF FIGURES

CHS	Cyber-Human Systems
CPS	Cyber-Physical Systems
ERP	Enterprise Resource Planning
IFC	International Finance Cooperation
IOTs	Internet of Things
IT	Information Technology
P2P	Peer – to – Peer
POW	Proof of Work
SC	Supply Chain
SCM	Supply Chain Management
SMAC	Smartchem
SCOR	Supply Chain Operations Reference
SPSS	Statistical Package for Social Sciences
TOE	Technology, Organisation and Environment
UWC	University of Western Cape

1. CHAPTER ONE – INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 Introduction

Arguably, there is a need to carefully plan and manage the entire spectrum of activities relating to sourcing and procurement. According to Basu and Wright (2010), supply chain management (SCM) includes all activities related to sourcing and procurement, conversion and logistics management, as well as coordination and collaboration with channel partners who may be suppliers, intermediaries, third-party service providers, or customers. The continuous improvement of information technology integration into SCM is a critical factor in organisational development aimed at achieving goals and creating a competitive advantage in the global market. This advancement outperforms older systems with restricted storage, handling, oversight, decoding and visualising capabilities (Darvazeh, Vanani & Musolu, 2020). This has yielded a rapid shift from traditional to digital supply chains with the primary goal of overcoming human physiological constraints and providing insights into better efficiencies, waste elimination, and increased revenues.

While other areas of SCM have been optimised by digital transformation to enhance insights and efficiencies, logistics remains fragmented and has become the main source of supply chain errors (Yang et al., 2021). According to Takita and Leita (2018), logistics can be described as a set of processes and procedures aimed at ensuring the effective flow and distribution of materials and information from the source to the point of production. This may involve the flow of raw materials, purchased parts, machinery, supplies, goods and services used in the production system (Takita & Leita, 2018). This study aims to explore the factors affecting the adoption of blockchain in logistics in South Africa, with a specific focus on technological, organisational, and environmental factors.

1.2 Background

Scholars have argued that for any organisation to achieve a high return and create value for their customers, they must embrace efficient and effective supply chain management (Afande, Ratemo & Nyaribo, 2015; Moberg et al., 2002; Childhouse & Towill, 2003). Goldratt and Cox (2016) contend that supply chain management

addresses issues and provides answers to the problem of optimising operations in any business system. According to Goldratt and Cox (2016), the purpose and mission of supply chain management are to maximise throughput while simultaneously decreasing inventory and operating costs.

Based on the study of Afande, Ratemo and Nyaribo (2015), implementing high-quality grant chain management techniques gives a corporation a competitive advantage over its competitors, allowing it to increase income while reducing operating expenses. According to the Supply Chain Operations Reference (SCOR) model, there are five key performance drivers that companies can use to make decisions to define and enhance their supply chain capabilities: Plan, Source, Make, Deliver and Return (Thilakarathna, Dharmawardana & Rupasinghe, 2015).

Today's supply chains have become more complex, dynamic and more competitive, and digitisation has emerged as a new phenomenon underpinning every aspect of a successful supply chain. A successful transition from the traditional supply chain to digitisation is attributed to a competitive advantage, creating sustainable value for organisations (CapGemini, 2016; Mihardjo et. al., (2021). The digitisation of supply chain can be conceptualised as the emergence, proliferation and adoption of information systems and innovative technologies aimed at enhancing the integration and agility of supply chains with the ultimate goal of improving customer service and the sustainable efficiency of the organisation (Ageron, Bentahar & Gunasekaran, 2020).

Digitisation enables the seamless integration of systems across channel partners to improve efficiency by enabling organisations to integrate all suppliers and parts manufacturers into the supply chain network (Singh & Jayraman, 2013). Given the scholarship of Chienwattanasook and Jermsittiparsert (2018), integrating supply chain operations with suppliers and consumers allows businesses to streamline and enhance data sharing and knowledge, potentially improving material and product flows across the supply chain.

1.3 Research Problem Statement

Many companies still face challenges in the integration of blockchain technology into logistics in their transformation to a digital supply chain. Thus, logistics remains fragmented and has become the main source of supply chain errors. Scholars have acknowledged the serious challenges for blockchain implementations in SCM (Deshpande et al., 2017; Kshetri, 2018; Sulkowski, 2019; Queiroz & Wamba, 2019; Malyavkina et al., 2019). Unarguably, blockchain technology is revolutionary and making great strides in many areas. However, in the supply chain, certain impediments are bedevilling the widespread adoption of blockchain technology (Jabbar, Lloyd, Hammoudeh, Adebisi, and Raza, 2020). Scholars have highlighted some of the hindering factors as the lack of a clear understanding amongst most business leaders as to what blockchain is all about, the lack of support and enterprise resource planning tools within the systems and issues of scalability and interoperability. Jabbar et al. (2020) argue that the concern about the scalability and interoperability of the massive computing resources required for the implementation of blockchain technology is indeed a deep concern to business leaders in deciding whether or not to adopt blockchain technology. The isolation of blockchains in their respective 'silos' due to the lack of interoperability standards impedes their wider adoption.

Deshpande et al. (2017) maintain the potentially high costs of initial implementation, perceived risks associated with the early adoption of blockchain and the possibility of disrupting existing practices, which may pose significant challenges to businesses. Moreover, due to the nascent nature of the technology, there is a lack of clarity about the governance of blockchain systems (Deshpande et al., 2017). With these realities, the need to explore and establish the specific factors affecting the adaption of blockchain in logistics in South Africa has become imperative.

1.4 Research Questions

Main research question: Which factors affect the adoption of blockchain technology in logistics in South Africa?

Sub-questions:

a. What technological factors affect the adoption of blockchain technology in logistics in South Africa?

b. What organisational factors affect the adoption of blockchain technology in logistics in South Africa?
c. What environmental factors affect the adoption of blockchain technology in logistics in South Africa?

1.5 Research Objectives

- To identify technological factors affecting the adoption of blockchain technology in logistics in South Africa.
- To identify organisational factors affecting the adoption of blockchain technology in logistics in South Africa.
- To identify environmental factors affecting the adoption of blockchain technology in logistics in South Africa

1.6 Alignment of the primary research

Table 1-1: Alignment of the primary research

Author's own (2022)

Research question: Which factors affect the adoption of blockchain in logistics in South Africa?		
Research Sub-Questions	Which method/s do you envisage applying to answering the sub-question?	Which research objective will you achieve by answering this sub-question?
What technological factors affect the adoption of blockchain in logistics in South Africa?	Survey Literature	To identify technological factors affecting the adoption of blockchain in logistics in South Africa.
What organisational factors affect the adoption of blockchain logistics in South Africa?	Survey Literature	To identify organisational factors affecting the adoption of blockchain in logistics in South Africa.
What environmental factors affect the adoption of blockchain in logistics in the South Africa?	Survey Literature	To identify technological factors affecting the adoption of blockchain in logistics in South Africa

1.7 Location of study and scope of the study

In accordance with the objectives set out, this study was conducted nationwide in South Africa within the retail sector. The study conducted a national survey, using a convenient sampling method to select only retail organisations working in South Africa's logistics supply chain. An online survey was conducted with voluntary participants from these organisations to enable the researcher to establish the specific factors affecting the adoption of blockchain technology in logistics in South Africa.

1.8 Significance of the study

The findings and recommendations emanating from the study add to the body of knowledge on blockchain adoption and may provide useful insights for organisations, lawmakers and enthusiasts of blockchain technology in South Africa.

1.9 Assumptions and Limitations

Given the voluntary nature of the participation of participants in the survey, the researcher was only able to receive responses from willing organisations. This means that organisations that were unwilling to participate did not participate. Therefore, the sample size was not entirely representative of the organisations in South Africa.

1.10 Structure of the study

Chapter one of this study presents the background of the study and states the problem statement. Furthermore, the chapter outlines the research objectives, research questions and location and scope of the study. It also highlights the significance and contribution of the study and provides the chapter outline.

Chapter two, which is the literature review, provides a concise review of various literature sources that were consulted in an attempt to provide a rational review of previous research in the area of blockchain technology in the supply chain terrain.

Chapter three outlines the research methodology that was used in this study in terms of the research design, research method, data source, sampling method, units of analysis, data collection instruments, data analysis techniques and research ethics.

Chapter four presents data results, interpretation and discussion of the results.

Chapter five provides an insightful and thoughtful conclusion, recommendations and suggestions for future research.

1.11 Chapter summary

This chapter gave an overview of the background of the study, the problem statement, the objectives and research questions and significant aspects of the study, as well as the assumptions and limitations of the study. It also provided information relating to digital transformation, specifically on the quest for the adoption of blockchain technology aimed at enhancing organisational performance in the supply chain industry. This chapter, in summary, provided background knowledge with regard to the dynamics of digital transformation, with a special focus on the appetite for blockchain technology in the supply chain industry. The chapter is a prelude to the literature review chapter. Therefore, the next chapter presents the literature review.

2. CHAPTER TWO – LITERATURE REVIEW

2.1 Introduction

This section reviews recent research on the use of blockchain technology in supply networks. Several current papers have been examined. The chapter is divided into the following sections: previous study and theoretical framework, digital supply chain transformation, blockchain technology conceptualisation in logistics (digital supply chain), the contextualisation of blockchain technology in the South African logistics industry, the role of blockchain technology in improving organisational performance and the factors influencing blockchain technology adoption in logistics in South Africa.

2.2 Supply chain digital transformation

Traditionally, manual processes characterised supply chains where critical data for analytics had to be ingested manually, which had huge cost and integrity implications. In this scenario, decisions are made based on a responsive approach, where there's no real-time or live streaming of external data, such as delivery dates or distributor stock levels into the supply chain system. The emergence and proliferation of digital technologies have reshaped the supply chain and brought interconnectedness, responsiveness to change and enhanced transactions and communication among stakeholders.

The digital supply chain is mainly characterised by visibility throughout the supply chain network, where processes are automated with less human intervention, better communication and data flow between entities and enhanced collaboration. Digital supply chain capabilities enable the connection of the warehouse, distribution centre, storefront and e-commerce portal to ascertain that all points can exchange information and re-route orders. This ensures that customers have what they want at any location and at any time (LaBombard et al., 2019). This innovation permeates throughout product and process development, thus aiding organisations to reduce costs, improve profitability and enable competitive advantage. Singh and Jayraman (2013) claim that efficiency improvements occur through practices to cut down on production and manufacturing costs and seamless integration of systems across channel partners.

A digital transformation is a process of reinventing how a company operates using digital technology in order to become more efficient, adaptable and responsive to give more value to customers at a lower cost (Vial, 2021; Ebert & Duarte, 2018; Tabrizi et al., 2019). The potential wealth trapped in inefficient and slow processes, compounded across numerous trading partners, is enormous. A digital transformation is not only an upgrade of technology (Westerman et al., 2011), but a constant state of mind and a willingness to adapt and respond to an ever-changing corporate environment and an uncertain future (Vial, 2021). When planning procurement and manufacturing operations in isolation in such a manner that tends to distort the effective flow of information, it causes an undue delay in the processes and results in making partially or incompletely informed decisions. However, synchronising systems from scratch opens up many opportunities for transparency and collaboration. The more departments that know each other's updates, the more checkpoints there can be. As a result, response times are faster, and the process is overally more efficient. An additional benefit is that companies can better understand market demand and create an industry-wide master production system (MPS) (Jonsson & Ivert, 2015; Stroumpoulis & Kopanaki, 2022).

Most of today's supply chains consist of separate, isolated steps that span marketing, product development, manufacturing and distribution, ultimately reaching the client. Digitisation eliminates these barriers, transforming the supply chain into a fully integrated ecosystem that is completely transparent to all stakeholders, from suppliers of raw materials, components and parts to transporters of those supplies and finished goods, and finally, to the customers demanding fulfilment (Bienhaus & Haddud, 2018).

According to Oswald and Kleinemeier (2017), digitisation is defined as the process of changing from analogue to digital form, which is inevitable, irreversible, tremendously fast and ubiquitous. Once the digital supply "network" is established, it provides the organisation with a new level of resilience and adaptability, enabling enterprises that arrive first to outperform their competitors in their pursuit of the most efficient and transparent service delivery possible.

The next phase of supply chain management will be defined by the fundamentally new ways in which suppliers and customers will interact, blurring the lines between the

digital and physical worlds and eradicating old organisational boundaries (IFC, 2018; Mulligan, Godsiff & Brunelle, 2020). Examples from best practices suggest that digital platforms play a critical role in managing supply chain activities and partnerships that generate performance gains for firms. With the introduction of the digital supply chain, it is expected that each link would have complete visibility into the demands and challenges of the others. Supply and demand signals can begin at any point on the network and propagate instantly throughout it.

2.3 Drivers of digitisation

Digitisation is primarily fuelled and facilitated by technological advancements, such as social media, mobile computing, analytics/big data, cloud computing (SMAC; also known as 'the third platform'), the Internet of Things (IoT), cyber-physical systems (CPS), cyber-human systems (CHS) and cyber-security (SAP, 2015; Kowalkiewicz et al., 2016). The rapid and widespread adoption of digital technologies is facilitated by the dynamic behaviour of people, changing expectations and attitudes, most notably, the rate at which people embrace new technologies, how they engage with one another, make their decisions, share their experiences and impressions, buy and sell and how they want their work environment to be. These dynamics serve as a secondary driver of digitisation (Berman & Bell 2011) and are inextricably linked to the primary engine of rapid and widespread dissemination. Today's users acquire new technology at a rate that has never been seen before. Anders (2015) noted that WhatsApp, for example, garnered many more subscribers of over seven hundred million in its first six years of operation than Christianity did in its first nineteen centuries.

2.4 Conceptualisation of blockchain in logistics

Blockchain technology is well-suited for supply chain applications in part because it has the potential to yield an unparalleled level of transparency. In contrast to typically centralised databases, blockchain systems validate new entries or updates to the ledger using a cryptographic consensus technique, obviating the need for middlemen. This enables ordinarily distrustful parties, such as anonymous individuals and corporations, to conduct near-frictionless peer-to-peer transactions.

Kshetri (2018) elaborates on blockchain applications as a means of resolving trust challenges in supply chains. Decentralised application enthusiasts are thus encouraging early adoption of the technology for businesses to remain competitive in the market. Every day, new technologies are applied to the business environment, and a variety of technologies are utilised to assist businesses with information transmission and reception responsibilities. Numerous areas of the corporate and logistics environment have changed as a result of the fourth industrial revolution and the Internet of Things (IoTs), as individuals and organisations are now required to increase their productivity.

By and large, blockchain development and implementation in supply chains are in their infancy. Thus, as technology evolves, there are numerous opportunities for enterprises (Nowiński & Kozma, 2017). In particular, blockchain technology has the potential to increase communication amongst supply chain partners. Even currently, it is largely in the form of experiments and pilot projects in various commercial and public companies (Dujak & Sajter 2019). According to Christidis and Devetsikiotis (2016), two key aspects of blockchain technology are critical for its deployment and meaningful application in logistics and supply chains/supply networks:

- Real-time secure, verifiable and trustworthy transmission of information via blockchain that makes it accessible to all members of the supply network or anybody else (depending on the type of blockchain),
- Automated verification and execution of agreed-upon transactions when specific conditions are met using smart contracts and blockchain-based apps.

Based on these fundamental characteristics of blockchain, application areas for its usage in logistics and supply chains are evolving in a variety of directions. Key areas of blockchain adoption in logistics and supply chains include tracking product origin and product flow through the supply chain, demand forecasting, reducing counterfeiting and fraud, public access to supply chain information, reducing environmental impact and automation transactions (Dujak & Sajter, 2019; Pournader et al., 2020). In many cases, the blockchain application area is integrated with supply chain management, using blockchain to track production and product flows, as well as reducing the risk of fraud and more

accurately forecasting demand. Hackius and Petersen (2017) conducted a recent study on the usage of blockchain in the logistics and supply chain management industries, surveying 152 logistics specialists, including consulting, logistics services and sciences from Germany, the United States, Switzerland and France. The findings indicate that businesses are still unwilling to commit resources to potential blockchain uses.

Given its unique features, such as immutability, incorruptibility and the ability to provide complete transaction transparency, blockchain technology is gaining ground across the logistics sector. Blockchain technology has the potential to revolutionise every area of the logistics and supply chain industries. At the moment, efforts are being undertaken to ensure that blockchain systems can interact with data received from the Internet of Things (IoT) devices used in logistics and supply chains. The data in the ledger is distinct from typical centralised database systems, which use a cryptographic consensus technique to confirm the data in the ledger. The objective of the blockchain is to foster peer trust and establish secure networks for information sharing. This means that no authority or participant can alter or manipulate the data stored on the blockchain (Mougayar, 2016).

2.4.1 Features of blockchain

Mougayar (2016) argues that smart contracts are a critical technology that enables the use of blockchain in a variety of enterprises. It is the coding and uploading of a contract between parties to the blockchain.

Smart contracts may make the negotiation process and performance of a contract easier and more efficient. Usually, the interface of a smart contract is clear, and it imitates the logic of contractual clauses. The main aim is to secure the contractual processes and reduce the costs related to contracting *(*Kakavand, De Sevres, and Chilton, 2017)*.*

Smart contracts are nothing more than computer programmes that execute predetermined actions when particular system criteria are satisfied. Smart contracts define the transactional language that enables the ledger state to be updated. They

have the potential to allow the exchange and transfer of virtually anything of value, such as shares, money, content and property (Kakavand et al., 2017).

2.4.2 Suitability of blockchain in supply chain

Blockchain technology is well-suited for supply chain applications in part because it has the potential to yield an unparalleled level of transparency (Kshetri, 2018). In contrast to typically centralised databases, blockchain systems validate new entries or updates to the ledger using a cryptographic consensus technique, obviating the need for middlemen. This enables ordinarily distrustful parties, such as anonymous individuals and corporations, to conduct near-frictionless peer-to-peer transactions (Gautam, 2019; Vemuri, 2018). According to Kshetri (2018), blockchain applications have the capability of resolving trust challenges in supply chains. Enthusiasts of blockchain are thus encouraging early adoption of the technology for businesses to remain competitive in the market.

2.5 Contextualisation of blockchain technology in the South African logistics industry

Blockchain technology is rapidly gaining traction as a revolutionary force in the logistics industry, with the potential to redefine and remodel many of the country's present logistics systems and processes (Jagtap, 2020; Koh, 2020; Sadouskaya, 2017). Though blockchain technology is still relatively new in South African logistics organisations, it is advancing rapidly and is clearly positioned to impact critical functions within the logistics industry.

According to Collomb and Sok (2016), blockchain is fundamentally a distributed ledger that appears at several nodes of a network rather than a single, centralised site and is shared globally via peer-to-peer networks powered by computers and other devices. A consensus mechanism is included in the ledger, allowing the network to check the authenticity of transactions between parties.

This eliminates the requirement for an intermediary – such as a financial institution – to function as a third party. By using this technology, the blockchain offers a secure

and formidable exchange platform for shared logistics, allowing for the effective coordination of a wide variety of operations (Qi et al., 2022; Sarmah, 2018).

Blockchain technology is an unalterable digital ledger of economic transactions that can be configured to record nearly anything of value (Collomb & Sok, 2016). A prominent example of already-in-use technology is the Ethereum platform, a decentralised software that executes smart contracts guided by apps that operate exactly as planned, without the danger of downtime, censorship, fraud or third-party interference (Al-Jaroodi & Mohamed, 2019; Atzei et al., 2017).

The adoption of blockchain technology in the logistics business is likely to have far-reaching consequences, with some logistics experts describing blockchain as having "enormous potential" (Lesueur-Cazé,, Bironeau,Lux, & Morvan, 2020,p.2). Although blockchain technology has not yet reached the level of sophistication that it has in Asia, North America and Europe, it is gaining traction in African nations, such as South Africa. For logistics companies, the Ethereum platform is designed to improve price negotiation and inventory monitoring to reduce transaction costs and create more flexible supply chains as it seek to provide information used in the export or import process (Buterin, 2014). When import terminals receive a bill of lading data early in the process, shipping terminals and freight forwarders can plan and execute more efficiently without compromising sensitive information about cargo owners or values. Additionally, costly delays and losses caused by missing documentation will be avoided. South African logistics firms are continuously investigating and identifying significant technology trends that are reshaping their supply chains (Kuteyi & Winkler, 2022).

2.6 Role of blockchain technology in enhancing organisational performance

According to Felea and Albăstroiu (2013), a supply chain is described as the chain of numerous points involved in the production and delivery of commodities, beginning with the procurement stage and ending with the final client. Nowadays, the supply chain might include a variety of phases and locations. As a result, tracing events along the chain has grown increasingly complicated. Blockchain technology is increasingly being viewed as a next-generation information technology solution for long-term supply chain (SC) management growth. (Kim & Shin, 2019).

Blockchain technology is an innovative, "state-of-the-art," distributed and decentralised technology that ensures the confidentiality, integrity and availability of all transactions and data. It is a decentralised, open and shared ledger that enables the storage and recording of data and transactions over a peer-to-peer network (Choi, Chung, Seyha, and Young, 2020). Blockchain can be an effective option for restoring supply chains as a factor of transparency and security. Even the simplest application of blockchain technology can bring significant benefits to the supply chain. The registration of product transfers on the digital ledger as transactions enables the identification of the key data required to manage the supply chain (Qi et al., 2022; Sarmah, 2018). According to Kim and Shin (2019), an effective and strategic partnership between buyers and suppliers is one of the key success factors for supply chain management. Supply chain (SC) collaboration involves sharing key information from the global market and network activity and then making rapid collaborative decisions based on this information.

Blockchains could transmit data to the network in real-time about the origins of commodities, purchase orders, inventory levels, items received, shipping manifests and bills. Smart contracts compare this data to the agreement and trigger payment. When critical milestones are completed, such as products being issued (forming a shipment), pickup confirmed (activating a sensor) or evidence of delivery, it can autonomously activate further transactions (issuing an invoice). This happens automatically, without the need for spreadsheets or the manual creation of purchase orders or invoices (Liao & Wang, 2018). Smart contracts can also be used to initiate automatic payments, which may or may not be made in bitcoin or another cryptocurrency. Because the databases are decentralised, authenticity may be guaranteed even when no single entity claims ownership of the supply chain's data. Blockchain technology has the potential to provide extraordinarily secure and immutable access to supply chain data (Kim & Laskowski, 2016).

When paired with IoTs, using a blockchain can thereby increase transaction velocity and be a relatively low-cost solution. Each transaction may be traced and identified at any point in time, and once coded, the record cannot be easily altered. A transaction is validated by consensus among the various members, and once recorded, it cannot be readily amended or deleted because the chain is made up of blocks, and changing

an existing block would require the consent of the entire network (Crosby, Pattanayak, Verma, and Kalyanaraman 2016). Although the anonymity of a blockchain in a supply network is unlikely to be desirable, cryptographic PoW is essential for new blocks to be approved.

Blockchain technology has the enormous potential to alter every stage of supply chain management, from raw material purchase to consumer distribution (Goyat et al., 2019; Babich & Hilary, 2019). Additionally, each transaction may be reconstructed using blockchain technology, which speeds up and secures the journey.

2.6.1 Major weaknesses of blockchain technology

Blockchain technology has the potential to enable transparent and secure transactions. However, because blockchain transactions are irreversible, the receiver does not receive any refunds unless a fresh transaction is issued (Barber, Boyen, Shi & Uzun, 2012). Additionally, the laws and regulations governing the blockchain environment are unclear, which can cause consumer misunderstanding. Equally so, blockchain is not as inexpensive as some claim. Never underestimate the non-trivial operation and implementation costs of blockchain systems. Furthermore, buyers and customers cannot be certain of the genuine value of the products or services due to a lack of transparency in the supply chain. Moreover, some supply chain factors cannot be tracked, such as environmental events (Dickson, 2016).

2.7 Factors affecting the adoption of blockchain in logistics in South Africa

Given the advent of blockchain technology in 2008 and the introduction of Bitcoin, this decentralised peer-to-peer (P2P) blockchain technology has become one of the main business revolutionaries and is expected to be widely used in various industries and the service sector (Lakhani & Iansiti, 2017). A recent survey of industry experts and supply chain and logistics managers found that they are particularly willing to adopt blockchain technology in the context of supply chain (Pawczuk, Massey & Schatsky 2018) and transportation and logistics (Carter & Koch 2018). However, we are in the early stages of realising the full potential of blockchain technology in South African and global supply chain, logistics and transportation operations. Currently, there are many rumours about blockchain

applications, and commercialisation may take several years, but the future of this technology is bright (Moore. 2018). However, this is subject to conjecture.

Since business is performed without blockchain by default, several warehouses continue to operate using paper at critical moments. In other words, just because a technology exists does not mean that all sectors of business are willing to adopt it, especially in South Africa (Kuteyi & Winkler, 2022).

One of the most significant obstacles is that many current logistics industry leaders have a fundamental complexity to understand what blockchain is (Sarmah, 2018). Some dismiss it as a fad, content to wait it out, while others profit from the frenzy. Even those who are intrigued by the prospect are cautious about committing time and money to a technology that lacks industry-wide standards and procedures. Investing in blockchain technology without industry support is a costly proposition (Kuteyi & Winkler, 2022; Sarmah, 2018). To be effective with blockchain, everyone must speak with one voice. This means that the whole logistics community in South Africa will unite around a shared set of standards.

Additionally, it is critical to consider the practical and legal obstacles that blockchain will encounter for it to be adopted and developed in South Africa. Logistics firms may need to engage extra programmers and educate their legal teams on new business practices (Akinradewo, Aigbavboa, Edwards & Oke, 2022). For the majority of logistics firms, the current state of affairs is one of waiting for software, standards and processes to develop. Fortunately, several forward-thinking businesses recognise the potential blockchain holds for the logistics industry.

2.8 Previous Studies

Several previous studies on the factors affecting blockchain technology were reviewed in the study. These studies provide insight into the significant dimensions of blockchain adoption. A study by Hanna, Haroun and Gohar (2020) finds that the dimensions of security, regulatory support, competitive pressure, compatibility and complexity are found to have a significant effect on blockchain adoption. According to Jardim's (2020) exploratory study on identifying the drivers of blockchain adoption, the nine adoption factors considered were divided into two categories: adoption incentives and adoption

challenges. The adoption challenges consider external elements that may condition the adoption process, such as the dependence on other players' acceptance and adoption, the support and assistance given by the technology provider and the level of trust deposited in the technology itself. The Adoption Incentives category enumerated benefits and characteristics inherent to the technology, like automation and inefficiency reduction, traceability and information tracking, as well as the transparency guaranteed by smart contracts. The limitation of this study is that it merely presents the adoption drivers as a research framework without an empirical test being done on these nine drivers with a large-scale survey of firms.

According to a study by Choi et al. (2020) on the factors affecting organisations' resistance to the adoption of blockchain technology in supply chain networks, the findings revealed that the technological maturity, cost, compatibility and scalability of blockchain are significant disablers of blockchain adoption. Choi et al. (2020) suggest that the lack of regulations has a bad influence on the company adoption process. The study also demonstrates that companies are more likely to wait to adopt blockchain due to its complexity and immaturity. Nonetheless, like all studies involving surveys, the limitations of this study come from its level of objectivity. According to Choi et al. (2020), the study was conducted during a global pandemic, which affected the data collection process. I say this under correction, little research on blockchain technology in supply chains based on the South African context has been carried out. Given these realities, this study aims to bridge this gap.

2.9 Theoretical framework

According to Arnolado (2018), adapting blockchain technologies creates significant implications for organisations looking to meet the demands of the future. Arnolado (2018) argues that organisations adopting a new way of storing their data require a different skill set than what is already present in many organisations in terms of technological expertise. To better understand the underlying motivators and barriers that will lead or discourage companies from adopting blockchain technologies for supply chain traceability, a theoretical understanding is required.

To explain technology adoption in supply chains, the study reviewed two models for the adoption of technological innovation: the technology-organisation-environment

(TOE) framework (DePietro, Wiarda & Fleischer, 1990) and the diffusion of innovation (DOI) theory (Rogers, 1995). The TOE model explains that three different elements (technological, organisational and environmental) of an organisation's context influence adoption decisions. The Diffusion of Innovation (DOI) theory describes the pattern and speed at which new ideas, products or practices spread through the population (Rogers et al., 2014). Given the prescriptions of DOI, the key players in the theory are innovators, adopters, the early majority, the late majority and laggards. Five main factors influence the adoption of an innovation, and each of these factors is at play to a different extent in each of the five adopter categories. These factors, among other things, include relative advantage, compatibility, complexity, trialability and observability.

Both of these models have arguably been extensively used to predict and explain the adoption of several older technologies, as well as to investigate how to innovate, but none of them attempts to select a specific business context in which to implement blockchain technology in supply chain management.

Accordingly, this study aims at filling this knowledge gap by taking the first step towards defining a model tailored to the adoption of blockchain technology in the context of emerging economies, specifically in logistics organisations in South Africa. Furthermore, business organisation managers in the logistics industry can use this model adaptation to review the arguments for and against the adoption of blockchain technology in their organisation. As a result, the goal of this study is to identify relevant TOE (technology, organisation and environment) factors in the context of the South African logistics industry and assist them in determining the significance of adopting blockchain technology within their organisation.

All in all, the results in this study may indicate as to whether organisations in the logistics industry in South Africa have adopted or intend to adopt blockchain technology, and if so, what the most important drivers for adoption are. For the country's organisations, it may be important to look at the factors that affect the adoption of new and disruptive technology and, as a result, take action (Arnolado, 2018). Therefore, this study will discuss the dynamics of an organisation's context and its influence on blockchain adoption in logistics organisations in South Africa.

2.9.1 Technological factors

The factors below represent the technological factors that need to be considered when change management is implemented. This includes a variety of influencing factors, such as perceived blockchain technology characteristics, existing technology and data, and IT knowledge. Regarding the perceived characteristics of the technology due consideration is given to the scalability and interoperability of blockchain technology (Jabbar et al., 2020). According to Kühn, Jacob and Schüller (2019), the most mentioned perceived benefits of blockchain technology are high data security based on the distributed ledger and transparency. Given the study by Kalaitzi, Jesus and Campelos (2019) on the determinants of blockchain adoption and perceived benefits in food supply chains, the findings reveal that one of the perceived benefits of blockchain technology is to decrease communication or transfer data errors and fraud. Moreover, these scholars contend that blockchain technology enables the decentralised and immutable storage of verified data.

Considering the spread of innovations and technologies, Rogers (2010) provides a model that focuses on organisational-level innovation characteristics prior to decision-making in the persuasion stage. The first aspect influencing technology adoption is relative advantage, which can be defined as "the extent to which an innovation is regarded to be better than the idea it replaces." (Rogers, 2010.p 2). Rogers (2010) argues that while innovation may not always result in significant benefits, decision makers find inventions beneficial.

Tornatzky, Fleischer, & Chakrabarti (1990) identify critical factors that influence the process and rate of technology adoption in a business as technological, organisational and environmental factors. Firstly, the technological context refers to the characteristics of the technology that can be applied within or throughout a system, as well as the organisation's existing state of technology utilisation. It encompasses both a business's present operations and its equipment (Baker & Steiner, 2015). Secondly, the organisational context refers to the organisation's formal and informal structures, the status of innovation, the organisation's scope and size, slack resources and the communication process and managerial structures (Tornatzky et al., 1990).

2.9.2 Organisational factors

In this context, the main factors are the culture of the organisation and financial considerations. Scholars have widely argued that successful blockchain adoption necessitates extensive organisational support across multiple spectrums (Holotiuk & Moormann, 2019; Kamarulzaman et al., 2021; Wang & Xu, 2016). The study by Wang et al. (2019) identified top management support as a critical iterative factor in the adoption of IT innovations. Holotiuk and Moormann (2019) argue that the support of top management is on a high agenda in this context due to the investment required in the new technology, as managers need to value the technology's potential for things to happen.

Given the importance of organisational culture, it can be defined as the morals, values, perspectives, beliefs and invisible assumptions that employees publicly share inside the organisation (Giritli et al., 2006). According to Mogogole and Jokonya (2018), the culture of an organisation stimulates the innovative behaviour of staff in the organisation that can bring about change. It also refers to norms and ways of shared expectations, values and beliefs, which govern the behaviour of people in an organisation.

The financial considerations representing the anticipated high investments and sunk costs through a partial replacement of existing systems also form part of the organisational factors that could influence blockchain adoption in supply chains. Besides, further organisational considerations include rigorous IT governance standards and a significant need for process harmonisation.

A further consideration is the intra-organisational hurdle, which includes issues with departmental coordination (Hackius & Petersen, 2017). Change can be a hard process, which might result in opposition from some department members. Not all parties have the same perspective on the value of change. Additionally, the adoption of a new technology may alter the organisational culture hence necessitating the development of new functions, obligations, knowledge or aptitudes to manage and aid various aspects (Mendling et al., 2017). According to Viscusi et al. (2018), monopolistic power may likewise act as a barrier for new adopters. When it comes to

building the blockchain system, platform providers and developers wield considerable authority (Prewett et al., 2020).

Monopolies emerge when one company unfairly disadvantages other businesses by controlling the bulk of the supply of a particular product or service in the market. It is unclear in this situation if a blockchain platform provider will attempt to lock in consumers (vendor lock-in). Moreover, corporations may view knowledge as a competitive advantage when it comes to inter-organisational boundaries, which can be much harder. In supply chain networks, other firms' decisions inside the network should consider the individual firms' technology adoption thresholds, as well as their organisational characteristics. Due to this variability amongst organisations, which includes varying network sizes, prior beliefs and the amount of data observed, each firm makes an adoption choice at a different time (Choi, Chung & Lee, 2018). As a result, they may be unwilling to provide information and instead impose severe safeguards (Fawcett, Wallin, Allred & Magnan, 2009).

Most often than not, internal data is considered to be very confidential and organisations tend to keep it hidden from others. To overcome this barrier, businesses must have access to sufficient information (Gordon & Catalini 2018). Additionally, because each firm has its distinct culture, cultural differences can create friction in supply chain partnerships (Sajjad, Eweje & Tappin 2015). To use the system, the four horsemen of blockchain in supply chains, registrars, standards organisations, certifiers and actors, must be in place. If one of these fails, the entire system may suffer; network effect theory may be directly applied in this scenario. As a result, performance concerns may deter some people from adopting it (Abeyratne & Monfared, 2016).

Moreover, scholars have argued that organisational size has been widely used to predict IT adoption in companies (Clohessy, Acton & Rogers, 2018; Gutierrez et al., 2015; Tapscott & Apscott, 2016). There is an ongoing debate as to the ease of adoption of new technology between large firms and small firms. Gutierrez et al. (2015) and Schneider (2019) reason that small firms are more likely to adopt blockchain as they are more flexible given their lower levels of bureaucracy. However, some other scholars (Kalaitzi, Jesus & Campelos, 2019) disagree. Other scholars mentioned that only a handful of studies support that large firms have more resources

than small firms and can more easily take the risk of innovation adoption. Small firms will be laden with the burden of investing in IT infrastructure, new skill development and re-engineering processes, to mention a few.

2.9.3 Environmental factors

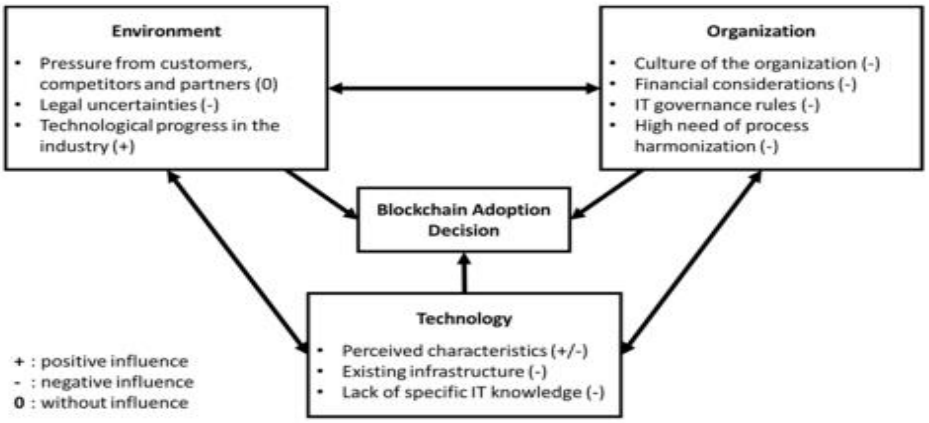
Similar to the organisational context, certain factors in the environment in which organisations are situated influence the adoption of blockchain, such as pressure from customers as well as competitors. According to Kühn et al. (2019), short contract periods impede investments into blockchain technology. Likewise, legal uncertainties in general, especially referring to smart contracts, represent impediments.

Choi et al. (2020) assert that government backing is critical for increasing the adoption of new technologies. The idea of a lack of government support in the form of financing or supportive legislation discourages businesses from exploring adoption. Despite the lack of restrictions, concepts and approaches like cryptographic signatures and smart contracts have been implemented. Firms and organisations are unsure of how blockchain will be regulated. For example, it is not obvious who would act as an arbitrator in conflict scenarios. Organisations must have an efficient technical infrastructure to fully exploit the benefits of such technology. For instance, a continuous and high-speed Internet connection and electricity are crucial components.

2.10 Conceptual framework

The TOE conceptual framework adapted by Kühn et al. (2019) to examine the factors affecting blockchain adoption in Germany's logistics service providers will be used as a basis to analyse the factors that facilitate or inhibit the adoption of blockchain in logistics in South Africa. The TOE framework (Figure 1) is made up of three fundamental components: technology, organisation and environment. These elements are briefly discussed below.

Figure 2-1: Factors affecting blockchain adoption: Adapted from Kühn, Jacob and Schüller (2019)



2.10.1 Technological factors affecting the adoption of blockchain in logistics

The factors below represent the technological factors that need to be considered in making informed decisions as to whether to adopt blockchain technology. This includes a variety of influencing factors such as perceived blockchain technology characteristics, existing technology and data and IT knowledge. Concerning the perceived characteristics of the technology with regards to scalability and interoperability (Jabbar et al., 2020), scholars argue that one approach to blockchain scalability solutions is to allow transactions to be offloaded to other blockchains; however, these blockchains must be interoperable (Coutinho et al., 2021). The problem is that current blockchains are not designed to be interoperable from the outset. Each blockchain is compartmentalised and focuses on resolving specific industrial problems (Coutinho et al., 2021). According to Kühn et al. (2019), the most mentioned perceived benefits of blockchain technology are high data security based on the distributed ledger and transparency. Existing technology could refer to IT heritage, inherited IT structure and past successes and failures in IT (Mogogole & Jokonya, 2018). Aside from the perceived features of blockchain technology, data quality is an important consideration.

2.10.2 Organisational factors affecting the adoption of blockchain in logistics

In this context, the main factors are culture of an organisation and financial considerations. Culture of an organisation can be described as the morals, values, views, beliefs and unseen assumptions that staff publicly share in the organisation. According to Mogogole and Jokonya (2018), culture can stimulate the innovative

behaviour of staff in the organisation to provoke a change in the culture of the organisation. This could also be referred to as norms, expectations, shared values and beliefs, which govern the behaviour of people in an organisation. The financial considerations representing the anticipated high investments and sunk costs through a partial replacement of existing systems also form part of the organisational factors that could influence blockchain adoption in supply chains. Further organisational considerations include rigorous IT governance standards and a significant need for process harmonisation (Akram et al., 2020).

2.10.3 Environmental factors affecting the adoption of blockchain in logistics

Similar to the organisational context, certain factors present in the environment in which organisations are situated influence the adoption of blockchain by organisations, such as government support, and pressure from customers and competitors. According to Choi et al. (2020), government support is crucial for expanding the adoption of new technologies. According to Choi et al. (2020), a lack of government support in the form of funding or favourable legislation prevents enterprises from investigating adoption. Nonetheless, in terms of the importance of external support regarding policy and legal framework, Kühn et al. (2019) warn that legal uncertainties stymie investments in blockchain technology. As seen in the study done by Kamarulzaman et al. (2021) on factors affecting blockchain adoption in government organisations, the Market Dynamics Support factor has a significant positive influence on blockchain adoption. Kamarulzaman et al. (2021) continued by referring to market dynamics supporting the rapidly changing blockchain technological landscape that forces organisations to review their existing business processes in order to assess how blockchain can be used as a technology differentiator, which could assist them to attract customers from their competitors. However, Clohessy et al. (2018) stated that how the incumbents and the new players divide the market and who provides the services that the consumers are willing to accept and adopt remains to be seen.

In addition, the duration of a contract and the blockchain regulatory framework, according to Kühn et al. (2019), as in short contract periods, impede investments into blockchain technology. Likewise, legal uncertainties in general, especially referring to

smart contracts depict impediments. Given the perspective of Kshetri (2018), blockchain applications were seen as a means of resolving trust challenges in supply chains. Hence, the enthusiasts of blockchain are encouraging early adoption of the technology for their businesses to remain competitive in the market.

2.11 Chapter Summary

The chapter has presented and articulated a discussion of the various literature that was reviewed in the study. The chapter provides the theoretical and conceptual framework of the study. Given the conceptual framework of the study, the TOE framework was presented as the conceptual framework to be adopted in the study for the evaluation of factors affecting the adoption of blockchain. The next chapter presents the research design and methodology used in the study for the collection and analysis of data in the study.

3. CHAPTER THREE - RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research methodology for validating the underpinning theoretical framework of the study on the factors affecting the adoption of blockchain in logistics in South Africa to assist organisations with blockchain decision making. The research design includes the research philosophical assumptions, research methods, data collection techniques, data analysis and presentation approach. The research design connects the research problem to the methodology, data collection technique and analysis strategy in order to answer the research question and enhance the study's validity (Yin, 2011). The researcher's philosophical assumptions, study method, data collecting and analysis all influence the research design (Creswell, 2009). This chapter presents the following: research philosophy, research paradigm, research approach, research design, research methods and the quantitative data collection

3.2 Research philosophy

The philosophical assumptions provide the paradigms (worldviews) that shape the development of the research. The researcher needs to articulate how different

paradigms are going to be integrated into answering the research problem. The positivism philosophy was used to integrate the findings as part of the discussion and conclusion. Creswell et al. (2011) contend that a philosophical framework helps to position and articulate how the design fits with the study. Neumann (2003) argues that positivism combines the social sciences with specific empirical observations of individual behaviour and deductive reasoning to discover and construct a set of probabilistic causal laws that can be used to understand broad patterns of predictable human behaviour.

Creswell et al. (2011) define a paradigm as the tradition of research regarded as authoritative by a particular community. Paradigms are sets of ideas, assumptions and beliefs that shape and guide a community's way of seeing things (worldviews).

3.3 Research paradigm

According to Morgan (2007), there are five types of paradigms namely, positivist, post-positivist, constructivist, participatory and pragmatist. These five paradigms, therefore, differ in terms of their philosophical elements, such as ontology, epistemology, axiology, methodology and rhetoric (Creswell et al., 2011). This study adopts positivism which focuses on facts with the view that only "factual" knowledge gained through observation (the senses), including measurement, is trustworthy. Therefore, the researcher takes the stance of an objective analyst and tends to distance oneself from personal values in conducting the studies. The methodology involved quantitative data as part of the research process.

3.4 Research approach

Positivism philosophy is based on the stance that to understand reality and develop knowledge, the reliability of empirical counts (quantitative) is imperative for a better understanding of a phenomenon. Positivism supports inductive as part of a research cycle to answer a research question (Morgan, 2007). While quantitative research is generally thought to be deductive, quantitative researchers often do a bit of inductive reasoning to find meaning in data that hold surprises (Kahlke, Sherbino & Monteiro, 2022). As argued by Kahlke (2022), the interpretation of quantitative results is not always clear and obvious in which findings do not always support or refute a

hypothesis. Thus, both qualitative and quantitative researchers need to be attentive to their data. Therefore, during the research cycle, the research used inductive or deductive inferences.

The research was conducted in its natural environment with the use of online surveys and questionnaires administered to the participants that were obtained from logistics in organisations in South Africa. The collected data from individuals within the logistics organisations in South Africa and artefacts (books and articles) in the supply chain field were utilised as units of analysis to be analysed in order to arrive at a particular conclusion (Creswell, 1998:14). The captured data gives very rich descriptive details concerning the participant's attitudes, feelings and experiences about the specific factors affecting the adoption of blockchain technology in their respective organisations.

3.5 Research design

Research design is conceptualised by De Vos (2002) as an overall plan for conducting scientific research. According to Babbie and Mouton (2001:74), a research design is a framework and guide as to how a particular researcher intends to conduct the research process. This study was conducted within the positivist research paradigm, which, among other things, uses a quantitative study design to eliminate the problem of unbiased researchers. As data were collected via an online survey, the researcher was not in direct contact with the participant. Thus, the anonymity of the respondents was guaranteed, and the objectivity of the researcher was not compromised (Muijs, 2004; Bryman & Cramer, 2012). The unit of analysis for the study was logistics organisations in South Africa and artefacts (books and articles) in the supply chain field.

3.6 Research methods

A research method is a study approach that shifts from simple philosophical assumptions to research design and data collection and affects how researchers gather data. The methods, techniques, tools and procedures used in carrying out

research projects are specified in research methodology (Mouton, 2002:36). The research goal is to investigate the factors affecting the adoption of blockchain in logistics in South Africa. Traditionally, the most common categories of research methods in information systems (IS) are quantitative and qualitative (Creswell, 2003; Oates, 2009).

3.6.1 Quantitative methods

Quantitative research collects information about the phenomenon using sampling methods and sending out online surveys and questionnaires. In quantitative methods, the researcher upholds a detached and objective interpretation to appreciate the facts (Duffy, 2018). The primary benefit of quantitative research design is that it is an outstanding way of finalising consequences and proving or disproving speculation (Shuttleworth, 2019). In this study, the quantitative method assisted the investigator in remaining impartial as questionnaires were administered. The avoidance of the investigator's contribution is the strength of this type of detached technique, which protects against bias and ensures objectivity.

3.6.2 Qualitative methods

According to Kaplan and Maxwell (2001), qualitative research typically entails a logical and detailed study of individuals in natural settings (as against settings contrived), using open-ended interviews to elicit in-depth accounts of experiences and perspectives of participants on specific matters and situations. Kaplan and Maxwell (2005) maintained that qualitative methods are more useful than solely quantitative ones when a researcher pursues to examine the dynamics of a process rather than its static characteristics. The qualitative method is suitable for investigating complex social phenomena using interviews but is time-consuming and difficult to use to cover a large group of participants (Morse & Niehaus, 2009; Peng, Nunes & Annansingh, 2011).

3.6.3 Mixed methods

The quantitative method (questionnaire surveys) is economical and efficient in collecting large samples of data but has weaknesses in investigating social contexts

associated with organisations. The qualitative method has been characterised by the limitation of being only suitable for investigating complex social phenomena using interviews and is time-consuming and difficult to use to cover a large group of participants. (Morse & Niehaus, 2009; Peng, Nunes & Annansingh, 2011). Given these realities, a mixed method of mixing or integrating qualitative and quantitative methods, data collection and analysis in a single study in order to better understand the research problem becomes imperative. Mixed methods research is a means to resolve widely perceived inherent limitations of a single method design to complex research problems (Peng et al., 2011; Waltz, 2014)

Justification of the method

As stated earlier, a quantitative research method was utilised for this study. Ulin, Robinson and Tolly (2004) argue that one of the basic principles of a quantitative method is that the goal of the research is the development of the most objective procedure for achieving the closest approach to reality. Quantitative approaches are used by researchers who utilise this approach to explain how variables interact, change events and cause outcomes. This study's primary purpose is to answer the research questions and derive practical outcomes. Objectivity is essential when researching a topic, such as blockchain technology, where the field is young and applications are frequently and rapidly updated. Working with a degree of openness and flexibility affords chances to get deeper insights into the topic that may not have been apparent at first. For this reason, a quantitative research method was used. The benefits of this survey method outweigh the inherent drawbacks and limitations, hence, it was correctly chosen for this study.

3.6.4 Data source

Data were collected from individuals within the logistics in South Africa and artefacts (books and articles) in the supply chain field. In social science research, there are several ways to collect data. These, amongst others, include observations, questionnaires, interviews and focus group discussions, to mention a few. Given the philosophy of this study, questionnaires were used. The questionnaire was administered to the respondent via the internet (online survey). The sampling method used in this study to select the target group was a convenient sampling method.

Convenience sampling is a type of non-probability or non-random sampling in which members of the target population are chosen for the study on the grounds of meeting certain specific practical criteria. Such specific criteria are easy accessibility, geographical nearness, willingness to volunteer and the availability of the participants at a specific time. However, Mackey and Gass (2005) point out that the obvious disadvantage of convenience sampling is that it is likely to be biased. Thus, researchers are advised not to consider convenient sampling as representative of the population.

The researcher decides to use convenient sampling because the specific numbers of organisations that are in the supply chain in South Africa are mostly unknown. There is no database of organisations in supply chains in South Africa. Some organisations might be appropriate to be included in the survey, but given the online nature of the survey, for example, organisations with no internet connectivity cannot form part of the survey.

3.6.5 Data collection instrument

As earlier indicated, an online survey was used in the study, and survey questions were administered to the participants digitally through the internet. The questionnaires were distributed to eighty (80) retail staff in South Africa, and six (60) questionnaires were completed and submitted to the researcher. This represented a survey response rate of 75%. The questionnaire (Annexure A) consisted of sixty-four questions (65). Nine (9) questions on the background information of the respondents were asked, and fifty-six questions were related to the factors affecting the adoption of blockchain in logistics. The purpose of the survey is to establish the specific factors affecting the adoption of blockchain in logistics in South Africa. Given the principles of TOE, the questionnaire principally focused on three sections, viz., technology, organisation, and environment. Fifty-six (56) questions in the questionnaire were specifically dedicated to exploring the dynamics of TOE, on average, eighteen (18) questions in each segment.

The questions were answered using the 5 Likert mixed scale through indicators ranging from strongly disagree, disagree, neutral, agree and strongly agree. The questionnaire was designed on the Likert scale to enable the researcher to collect data

that can quantitatively be analysed. For example, in technology, the researcher was interested in asking questions regarding the perceived characteristics of the technology with regards to scalability and interoperability, security, scalability and interoperability of existing technology with regards to IT heritage, inherited IT structure and past successes and failures in IT.

Regarding the organisations, questions relating to the culture of the organisation were asked, specifically as it tends to manifest in their morals, values, views, beliefs and unseen assumptions that staff publicly share in the organisation towards change management relating to the adoption of blockchain in their organisation. The study also explored the financial consideration of the organisation regarding the anticipated high investment in blockchain, IT governance rules and process harmonisation.

Given the environmental context, the researcher was able to establish the extent to which the pressure from customers, competitors and partners influenced the adoption of blockchain technology in organisations. Moreover, questions regarding technological pressure in the industry, as well as legal uncertainties regarding their impact on blockchain adoption, remain unanswered.

3.6.6 Sampling and survey

The research on factors affecting the adoption of blockchain in logistics in South Africa's logistics sector remains in its early stages. Given the objectives of this study aimed at investigating the various factors inhibiting blockchain technology adaptation in the logistics sector, insight knowledge into blockchain, as it applies to the logistics sector, was sought from the respondents. From answers to survey questionnaires, the researcher can examine different opinions surrounding the topic. As such, it was important to send the survey questionnaires to those placed at the leading edge of the decision-making process of blockchain and the logistics industry in South Africa. The questionnaires were thus sent to selected, active members of the blockchain and logistics sector in South Africa.

3.6.7 Data analysis

Quantitative research usually involves collecting and converting data into numerical form so that statistical calculations can be made and conclusions are drawn.

Miles and Huberman (1994) provided a comprehensive list of data analysis methods employed when drawing and validating results. The authors recommended tactics such as contrasts and comparisons to enhance comprehension and table splitting to highlight differences. The researcher adopted the following strategies to see things and their relationships more abstractly: subsuming particulars into the general, factoring, recognising relations between variables and identifying intervening variables. A logical chain of evidence and conceptual/theoretical coherence can be employed as strategies to construct a coherent understanding of data.

The resulting data from this study were then analysed using the Statistical Package for Social Sciences (SPSS). The study's findings were examined using descriptive statistics before being presented in the form of tables, charts and graphs.

3.6.8 Unit/s of analysis

The units of analysis for the study was logistics organisations within the supply chain industry in South Africa and artefacts (books and articles) in the supply chain field.

3.6.9 Location of study

A nationwide study was conducted in the retail sector of South Africa following the stated objectives. Simply put, the study was a national survey employing sampling to pick only logistics supply chain organisations in South Africa. The researcher was able to determine the particular parameters influencing the adoption of blockchain technology in logistics in South Africa by relying solely on voluntary participation from specified organisations in an online poll.

3.7 Research quality

Research quality is characterised by dependability, validity, trustworthiness and ethical methods. Reliability or dependability relates to the consistency of research

techniques (Morrow, 2005). Reliability ensures that all data are included, and none are lost due to incorrect recordkeeping or inaccurate transcriptions. Transparency and accessibility to the research process and the researcher's conclusions reflect the dependability of research.

In research, transparency implies that the researcher's methodology and decisions are documented and accessible to other researchers (Matthews & Ross, 2010). However, according to Soldaa (2011), after data processing and the formulation of significant conclusions, credibility and dependability are more suitable for qualitative research. These are two considerations while collecting and analysing data and presenting the results. Several methods exist for establishing credibility in a quantitative research report. Firstly, it is essential to cite the most influential authors of linked publications in the literature review. Secondly, credibility can be established by specifying the data analytic methodologies used by the researcher, either through participant confirmation of data analysis or by describing how data were triangulated. When the researcher informs the reader of his research process, he enhances the writing's trustworthiness and reliability (Saldaa, 2011).

This research's credibility was demonstrated by introducing the literature review procedure. The researcher attempted to increase the study's reliability and dependability by writing a coherent report that included an introduction and explanation of the significance of the study, the research topic, research objectives and clarification of the research question, as well as a relevant literature review and analysis of empirical data. In addition, the survey questionnaire questions are included in the thesis's Annexures for further analysis.

3.8 Assumptions and Limitations

Given the voluntary nature of the participation of participants in the survey, the researcher only received responses from willing organisations, which means organisations that were unwilling to participate did not. Therefore, the sample size may not entirely be representative of the logistics organisations in South Africa.

3.9 Ethical considerations

The study was conducted in accordance with the commonly accepted principles and values of scientific research. According to Babbie and Mouton (2001), conducting scientific research requires knowing a general agreement on what is appropriate and what is inappropriate in conducting scientific research. It is very important to preserve ethical values, such as the voluntary participation of participants in surveys, the anonymity and confidentiality of the identity of respondents and the integrity of reports. It also sought ethical approval from the UWC Research Ethics Committee (Annexure B). Babbie and Mouton (2001) claim that although researchers have a moral obligation to seek truth and knowledge, and this pursuit should not sacrifice individual rights in society. As a result, participants were informed that all information obtained in this study would be treated with strict confidentiality and would not be used for any purpose other than academic research. Before questionnaire administration, participants were given a project information sheet (Annexure C), along with a consent form (Annexure D). Respondents were duly assured that their participation was voluntary and that they would sign and return the informed consent to the researcher if they decided to participate. All the participants in this study were informed that their responses would be used in this study.

3.10 Chapter summary

This chapter provided the research design and methodology that were used in the study for the collection and analysis of data in this study. The study was based on a positivist approach. Hence, a quantitative method of study was employed in the study. The chapter provided insight into the target population, the unit of analysis and the instrument that was used to collect the data. It was mentioned in the study that an online survey was carried out among representatives of logistics organisations in South Africa. The chapter has also articulated how the data collected in the study was analysed. The following chapter presents the data results and a discussion of the key findings.

4. CHAPTER 4 - STUDY RESULTS

4.1 Introduction

The aspects of research methodology have been discussed in the previous chapter. This chapter presents the results that were derived from the data analyses. The objective of this research is to explore the factors affecting the adoption of blockchain in logistics in South Africa. The results as stated, are presented using descriptive statistics with the frequencies incorporated with charts and graphs for each variable, analysis of variance and correlations. This chapter examines the research's primary results, the efficacy of the technique used and the supporting literature that surrounds the study's questions and objectives. As a result, the discussion of the findings focuses on the research questions in connection with the data collection methods.

4.2 Analysis of data and research results

The research results are presented in this section of the study. The questionnaire was distributed to ten (75) logistics organisations in South Africa, and six (60) questionnaires were completed and submitted to the researcher. The questionnaire consisted of sixty-four questions. Eight questions on the background information of the respondents were asked, and fifty-six questions were related to the factors affecting the adoption of Blockchain. The questions were answered using the 5 Likert mixed scale through indicators ranging from, strongly disagree, disagree, neutral, agree and strongly agree. Below is a presentation of the results emanating from the data. The results are grouped into four main categories, namely the demographic characteristics of the participants and the technological, organisational and environmental factors influencing the adoption of blockchain.

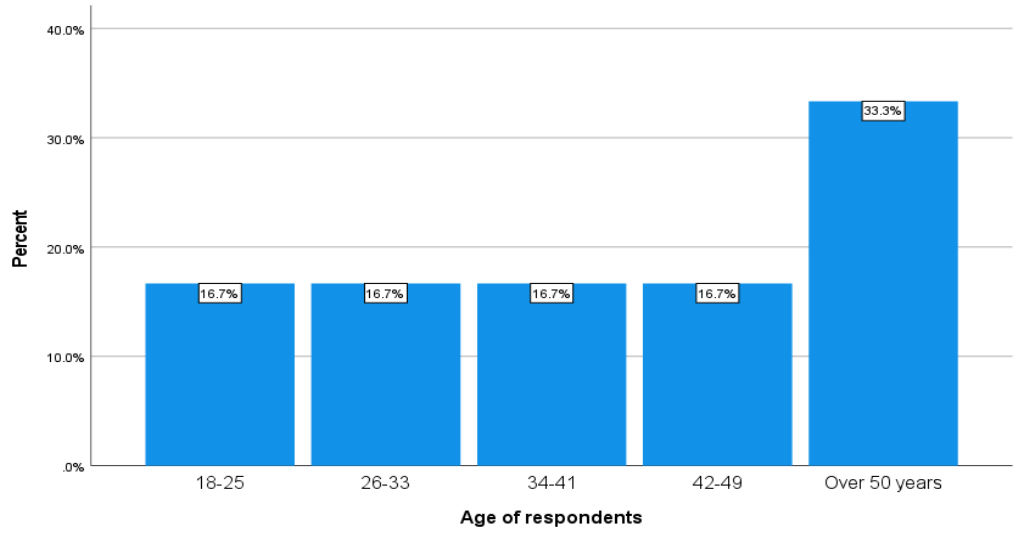
4.2.1 Demographic distribution of participants

This section presents the biographical characteristics of the participants/respondents in relation to age, gender, position, duration in the company, educational level, blockchain experience, location of the company, number of employees and company’s experience in blockchain adoption. The characteristics of these variables are presented below.

4.2.1.1 Age

The age distribution of the respondents that participated in the study is shown below in Figure 1. As shown in Figure 4.1, the findings of the study reveal that a higher percentage (33.3%) of participants were over 50 years of age, while 16.7% of the participants were within the respective age groups of 18–25, 26–33, 34–41 and 42–49.

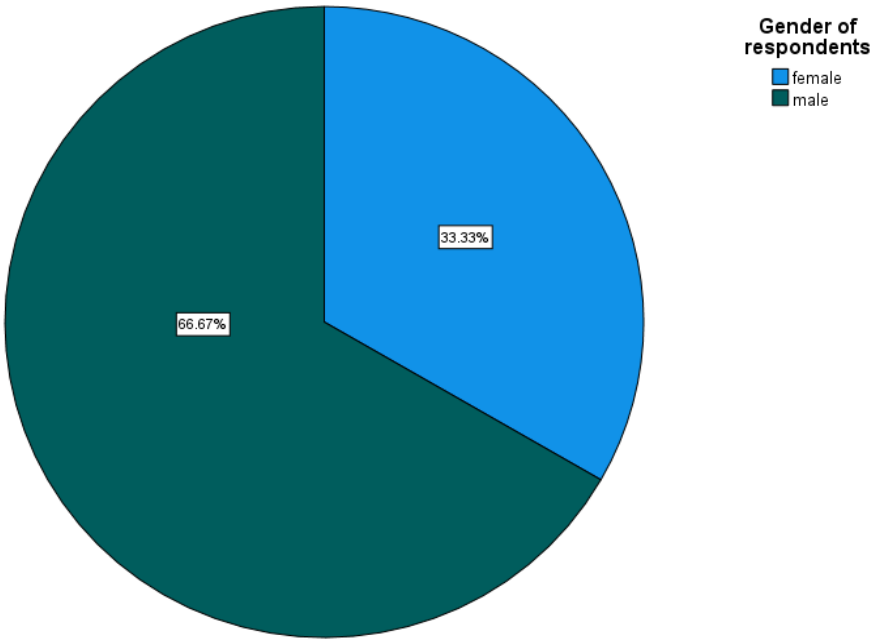
Figure 4-1: Age distribution of participants/respondents



4.2.1.2 Gender

The pie chart in Figure 4.2 below represents the distribution of gender of participants in the study. Thus, it shows 66.7% and 33.3% of males and females, respectively.

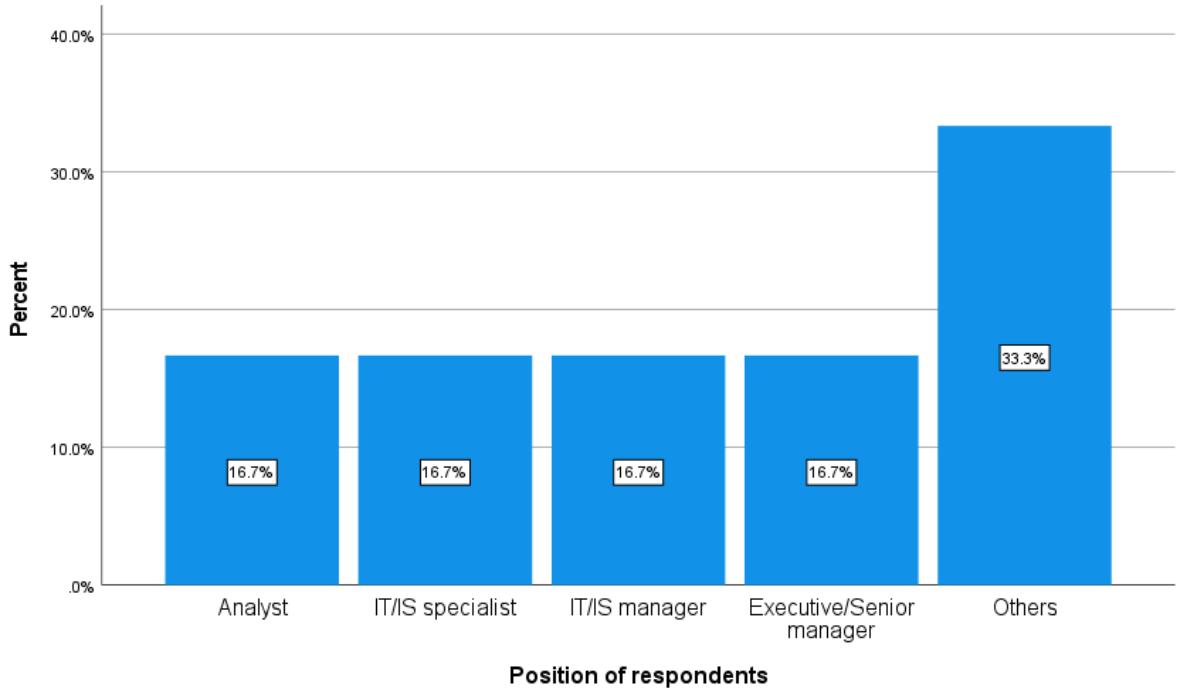
Figure 4-2: Gender distribution of participants



4.2.1.3 Position

Figure 4.3 below shows the percentage distribution of positions held by respondents in their various organisations. The respondents occupy various positions in their organisation, ranging from analyst (16.7%), IT/IS specialist (16.7%), IT/IS manager (16.7%), executive/senior manager (16.7%) and others (33.3%).

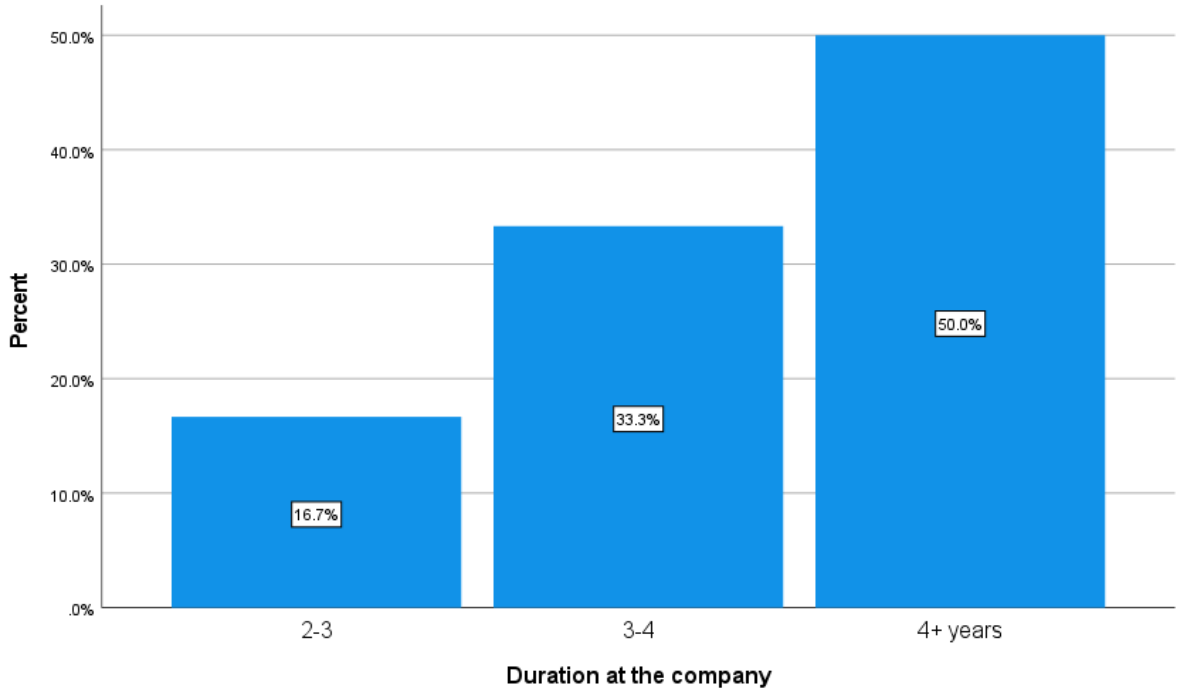
Figure 4-3: Distribution of respondent positions in their organisation



4.2.1.4 Duration in the company

Figure 4.4 below displays the percentage distribution of the respondents' duration in their respective companies. Given the figure below, 50% of the respondents have been working in their respective organisations for over 4 years. Whilst 33.3% of them have been in their organisation for a duration of between 3-4 years, 16.7% of them had a duration of between 2-3 years with their respective organisations. This configuration shows that the majority of the respondents have been with their respective organisations for a reasonable number of years. This provides credence to the quality of data obtained from the respondents.

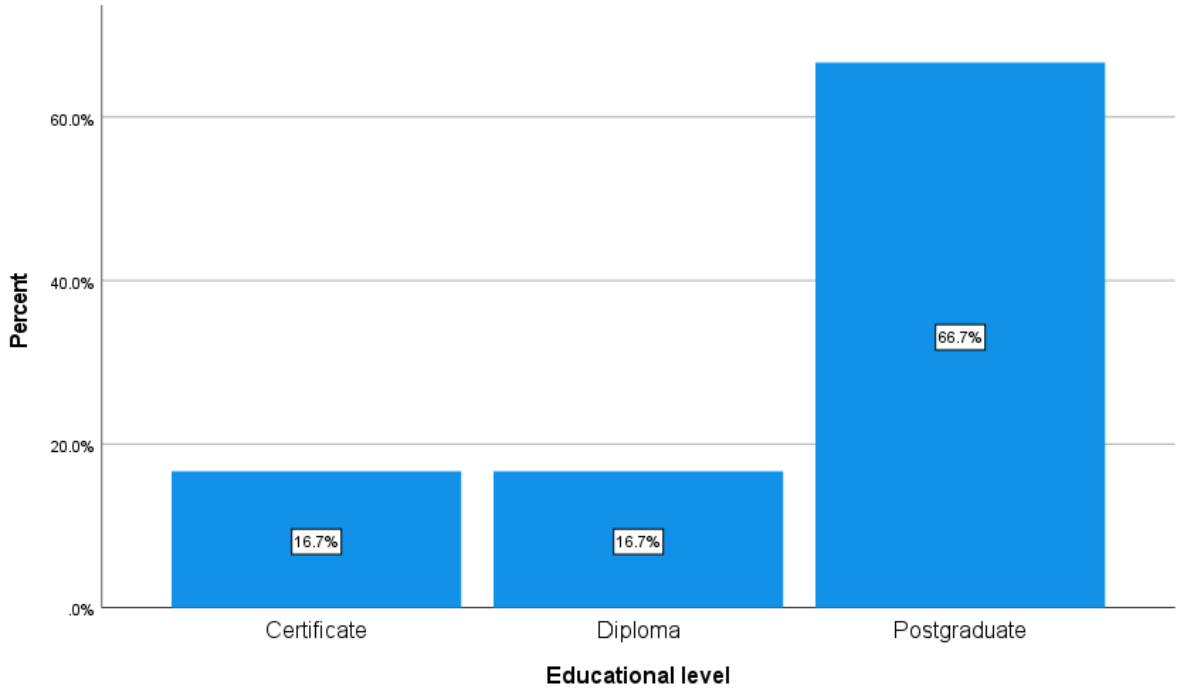
Figure 4-4: Distribution of Respondents' duration at the company



4.2.1.5 Educational level

Figure 4.5 displays the educational attainment levels of the respondents, whereby 66.7% of the respondents had a postgraduate degree, and 16.7% of the respondents had a diploma, and another 16.7% of the respondents had a certificate qualification. The scholastic attainment of the respondents also provides credence to the quality of the obtained data, as the majority of the respondents have postgraduate qualifications.

Figure 4-5: Distribution of education level of respondents

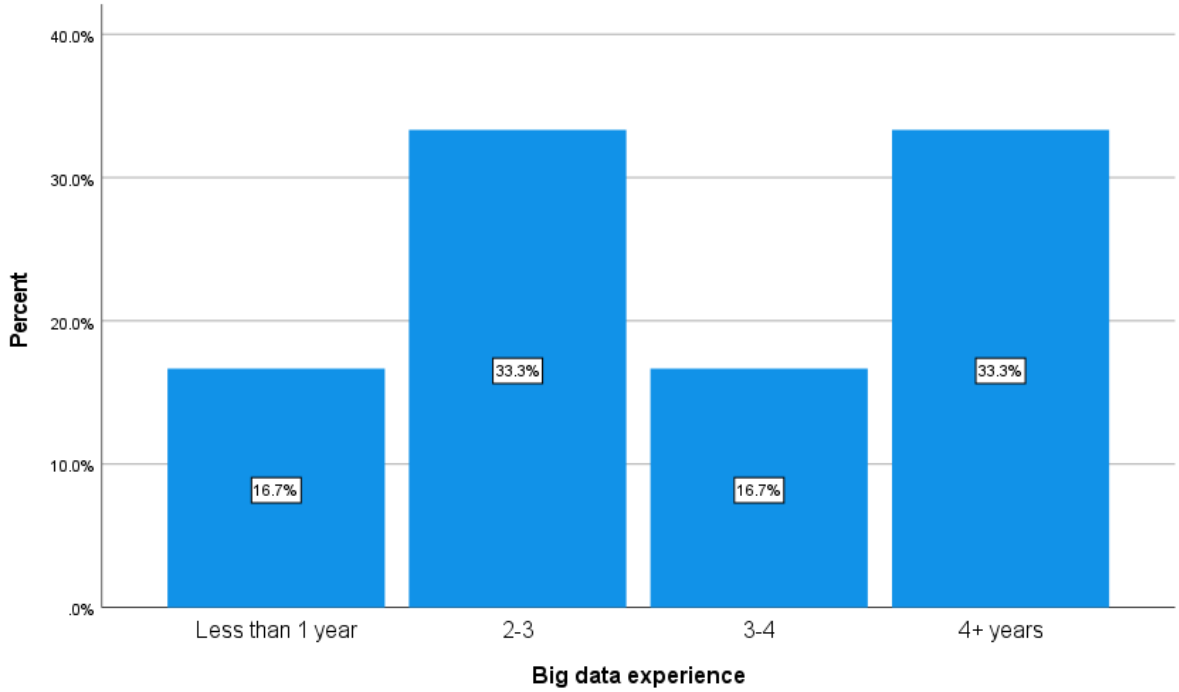


4.2.1.6 Blockchain experience

Figure 4.6 below shows the data experience of the respective organisations of the respondents. Given the figure below, 33.3% of the respondents work for an organisation that has between 2 and 3 years of experience, as well as over 4 years of experience in dealing with blockchain. While, on one hand, 16.7% of respondents work in organisations with 3–4 years of experience, another 16.7% of the respondents work for organisations with less than 1 year of experience in handling blockchain. Drawing from this distribution, it can be deduced that the majority of the respondents' organisations have adequate experience with blockchain, which can also be an advantage to the quality of data collected in this study.

.

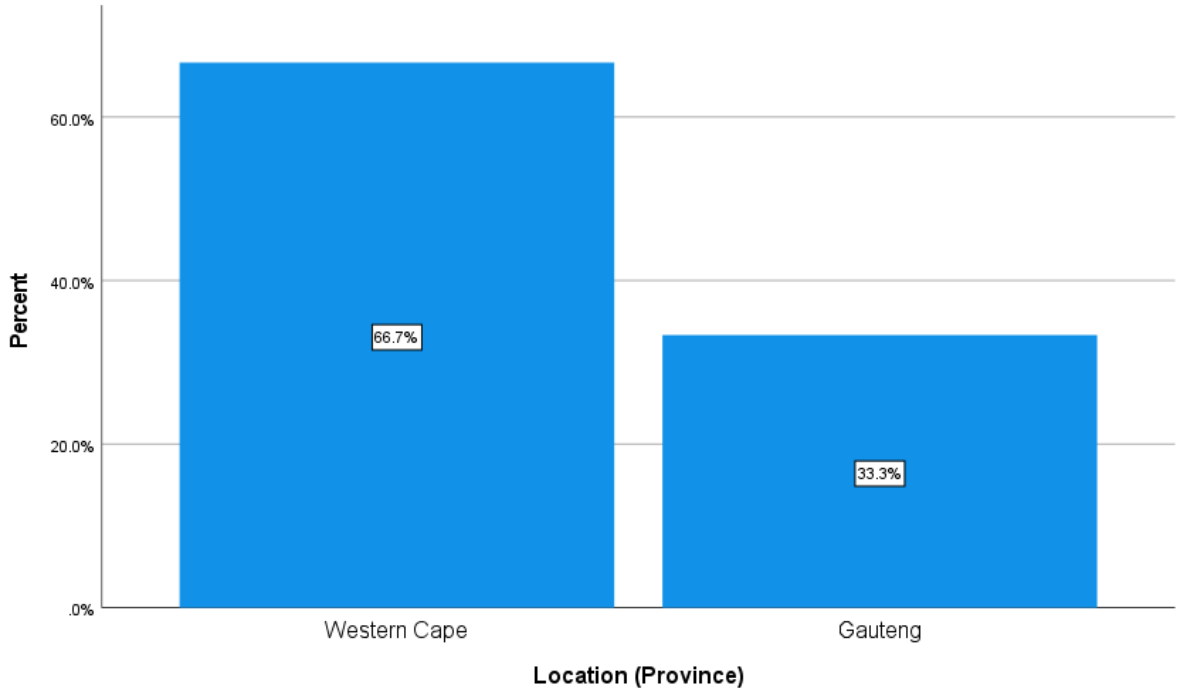
Figure 4-6: Blockchain experience of respondents' company



4.2.1.7 Location of company

Figure 4.7 shows the percentage distribution of the respondents' respective organisations' locations. Whilst 66.7% of the respondents' organisations are in Western Cape province, 33.3% of the organisations are in Gauteng province.

Figure 4-7: Distribution of respondents' company location

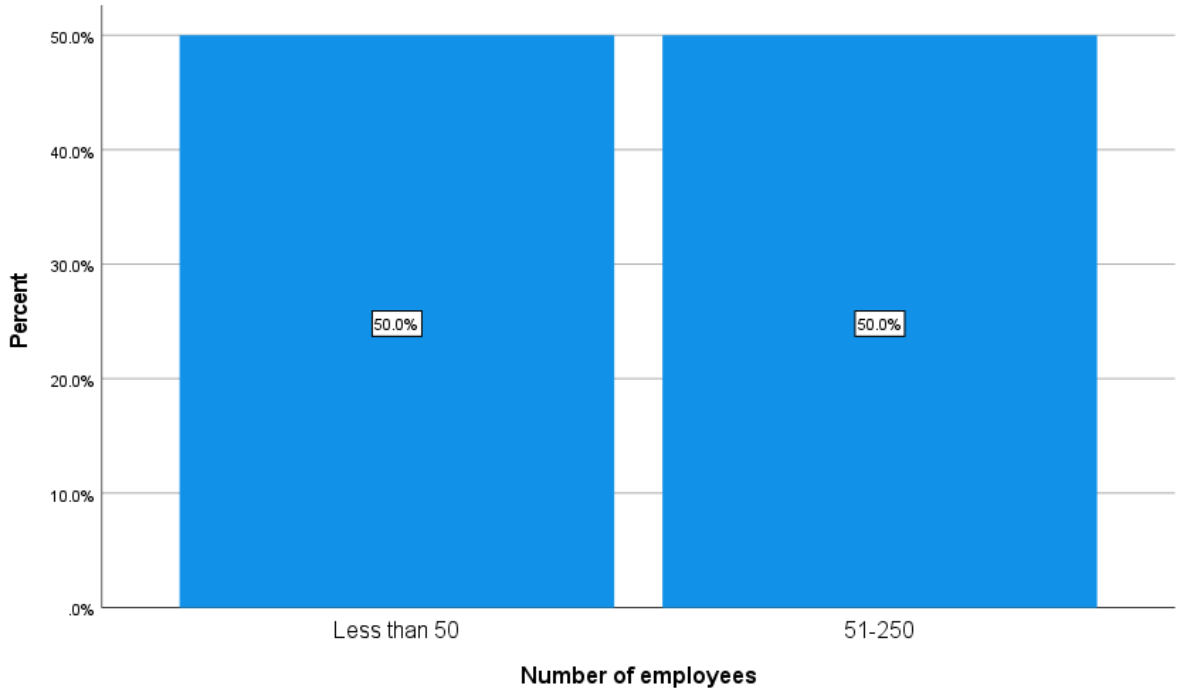


4.2.1.8 Number of employees

Figure 4.6 shows the percentage distribution of the respondents' respective organisations' number of employees. Whilst, on one hand, 50.0% of the respondents' organisations had fewer than 50 employees, on the other hand, another 50.0% of the respondents' organisations employed between 51-250 employees.

.

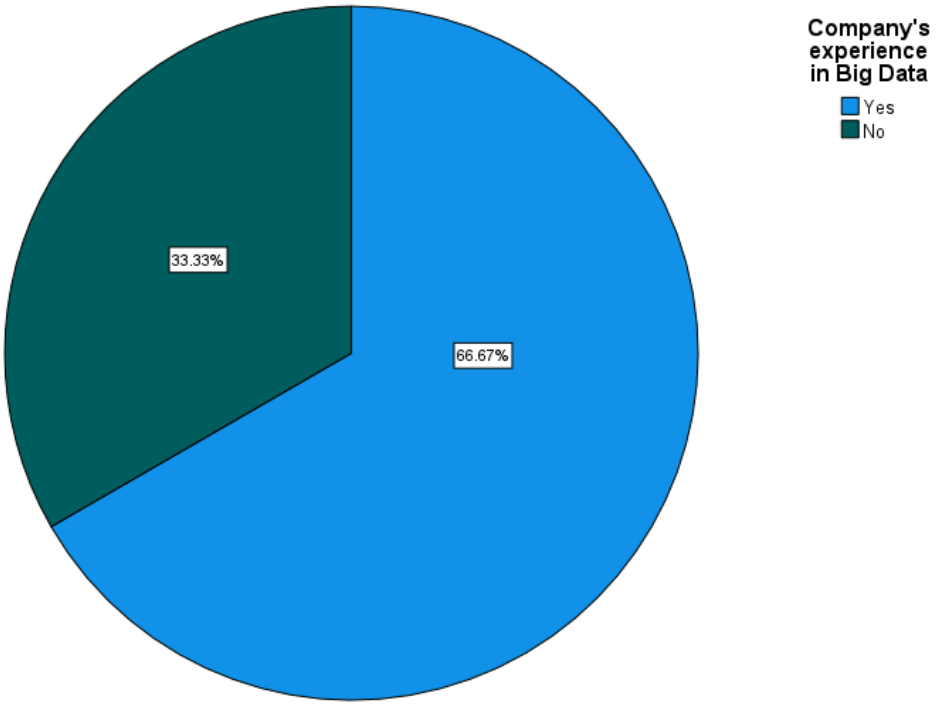
Figure 4-8: Distribution of numbers of employees in respondents' company



4.2.1.9 Company's experience in blockchain

Figure 4.9 depicts the respondents' respective organisations' blockchain experience. Given the figure below, 66.7% of the respondents work for organisations with experience in blockchain. The remaining 33.3% of respondents work in organisations with no experience with blockchain. Drawing from this distribution, it can be deduced that the majority of the respondents' organisations have adequate experience with blockchain, which can also be an advantage to the quality of data collected in this study.

Figure 4-9: Distribution of respondents' company experience in blockchain



4.2.2 Factors affecting the adoption of Blockchain

The data below presents the results for the perceived factors affecting the adoption of blockchain. These factors are grouped into three segments vis-à-vis, technological factors, organisational factors and environmental factors affecting the adoption of the blockchain. The results from the respective groups are presented below.

4.2.2.1 Technological factors affecting blockchain adoption

The results from the technological factors affecting the adoption of blockchain by organisations are presented under the following categories: perceived benefits, perceived complexity, perceived compatibility, technological availability and security. Data for each category are presented below.

4.2.2.1.1 Perceived benefits

Data are grouped into three segments namely, improved data security, improved data transparency and improved data quality, as shown in Figure 4.10 below.

Table 4.1**: Tabular frequency distribution of perceived benefits**

		Count	Column N %
Improved data security	Agree	40	66.7%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Improved data transparency	Neutral	20	33.3%
	Agree	10	16.7%
	Strongly Agree	30	50.0%
	Total	**60**	**100.0%**
Improved Data quality	Neutral	20	33.3%
	Agree	10	16.7%
	Strongly Agree	30	50.0%
	Total	**60**	**100.0%**

Improved security data

Table 4.1above shows a frequency table of the data emanating from the study regarding improved data security. Data reveal that whilst the majority (66.7%) of the 60 participants in the survey agree, 33.7% of the participants strongly agree that blockchain technology helps to improve data security.

Improved data transparency

Regarding the improved data transparency, Table 4.1 reveals that the majority of the participants agree (50% strongly agree and 16.7% agree) that blockchain technology helps to improve data transparency. However, 33.3% of the participants prefer to remain neutral.

Improved data quality

Table 4.1above shows that whilst the minority (33.3%) of the participants in the survey prefer to be neutral, majority (50%) of the participants strongly agree, and 16.7% agree that blockchain technology helps to improve data quality.

From the above results, it can be deduced that the decision to adopt or not to adopt blockchain technology is influenced by the perceived benefits of the technology. These findings seemingly substantiate the scholarship of Kühn et al. (2019), who argue that the most mentioned perceived benefits of blockchain technology are high data security based on the distributed ledger and transparency. Blockchain technologies promise to provide extremely secure and immutable access to supply chain data (Kim & Laskowski, 2016). This means that no authority or participant can alter or manipulate the data stored on the blockchain (Mougayar, 2016).

However, Gordon and Catalini (2018) contest that internal data is very confidential and is kept hidden from others. Given this pitfall, organisations may be unwilling to provide information and instead impose severe safeguards (Fawcett, Wallin, Allred & Magnan, 2009).

4.2.2.1.2 Perceived complexity

The frequency table of the data emanating from the study regarding the perceived benefits is shown in Table 4.2 below. Data are grouped into four segments with respect to implementation, operability, maintenance and adaptability.

Implementation

Given the data shown in Table 4.2 below, 33.3% of the survey participants disagree with the statement that blockchain technologies are easy to implement. As it relates to the issue of the perceived complexity of blockchain technology, similarly, whilst another 33.3% of the participants in the survey prefer to remain neutral, the remaining 33.3% of the participants agree that blockchain technologies are easy to implement.

Operability

Regarding operability, whilst a minority (33.3%) of the participants in the survey agree with the statement that blockchain technologies are easy to operate, the majority (66.7%) of the participants prefer to remain neutral to the statement.

Maintenance

Regarding the concern for maintenance, whilst 50% of the participants in the survey agree with the statement that blockchain technologies are easy to maintain, the remaining 50% of the participants prefer to remain neutral to the statement.

Adaptability

Given the concerns about the adaptability of blockchain technology, on average, the majority (50%) of the participants in the survey agree with the statement that blockchain technologies are easy to learn by their respective company's employees. Whilst 16.7% of the participants disagree with the statement, the remaining 33.3% prefer to remain neutral on the statement as to whether blockchain technologies are easy to learn by a company's employees.

The theoretical framework of the study, as argued by Jabbar et al. (2020), suggests that one of the technical challenges to be addressed before the mass adoption of blockchain would be scalability and interoperability.

Table 4.2 : Tabular mean distribution of perceived complexity of blockchain

		Count	Column N %
Implementation	Disagree	20	33.3%
	Neutral	20	33.3%
	Agree	20	33.3%
	Total	**60**	**100.0%**
Operability	Neutral	40	66.7%
	Agree	20	33.3%
	Total	**60**	**100.0%**
Maintenance	Neutral	30	50.0%
	Agree	30	50.0%
	Total	**60**	**100.0%**
Adaptability	Disagree	10	16.7%
	Neutral	20	33.3%
	Agree	20	33.3%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**

4.2.2.1.3 Perceived compatibility

Table 4.3 below shows a frequency distribution of the data emanating from the study regarding the perceived compatibility. Data are grouped into four segments namely, compatibility with the company's IT structure, compatibility with data used in the company, compatibility with the company's values and compatibility with the company's existing operations.

Compatibility with the company's IT structure

Given the data shown in Table 4.3 below, 50% of the survey participants agree with the statement that blockchain technologies are compatible with their company's IT structure. The remaining 50% of the participants prefer to remain neutral.

Compatibility with data used in the company

Regarding the concerns about the compatibility of blockchain technology with data used in the company, the majority (67.7%) of the participants in the survey agree with the statement that blockchain technology is compatible with the data used in their respective organisations. The remaining 33.3% prefer to remain neutral.

Compatibility with the company's values

Regarding the concerns about the compatibility of blockchain technology with the company's values, the majority (67.7%) of the participants in the survey agree with the statement that blockchain technology is compatible with the data used in their respective organisations. The remaining 33.3% prefer to remain neutral

Compatibility with the company's existing operations

Regarding the concerns about the compatibility of blockchain technology with the company's existing operations, the majority (67.7%) of the participants in the survey agree with the statement that blockchain technology is compatible with the data used in their respective organisations. The remaining 33.3% prefer to remain neutral.

The findings from the results show that the majority of the participants in the survey agree that compatibility with a company's existing IT structure is an influencing factor

for blockchain adoption. For compatibility with the data used in the company, the majority of the participants also agree with the statement that the data used in their organisation is compatible with that of blockchain technology. Similarly, whilst the majority of the participants also agree with the statement that their organisations' values are compatible with blockchain technology adoption, equally, majority of the participants agree that the existing operations of their organisations are compatible with blockchain technology.

Given the mentioned results, it can be deduced that the majority acknowledged the imperativeness of compatibility on the choice decision of organisations not to adopt blockchain technology. According to Mogogole and Jokonya (2018), existing technology factors need to be considered when change management is implemented. Existing technology could refer to IT heritage, inherited IT structure and past successes and failures in IT (Mogogole & Jokonya, 2018). Similarly, Mogogole and Jokonya (2018) maintain that the culture of the organisation, as reflected in its morals, values, views and beliefs, stimulate the innovative behaviours of the staff in the organisation that can bring about change.

Table 4.3 : Tabular frequency distribution of perceived compatibility

		Count	Column N %
Compatibility with company's existing IT infrastructure	Neutral	30	50.0%
	Agree	30	50.0%
	Total	**60**	**100.0%**
Compatibility with the data used in a company	Neutral	20	33.3%
	Agree	30	50.0%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**
Compatibility with company's values	Neutral	20	33.3%
	Agree	20	33.3%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Compatibility with company's existing operations	Neutral	20	33.3%
	Agree	20	33.3%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**

4.2.2.1.4 Technology Availability

Table 4.4 below shows a tabular frequency distribution of the data emanating from the study regarding the perceived compatibility. Data are grouped into five segments namely, the company's accessibility to external data sources, use of automated data capture, consistency of stored data in a database, concerns with incomplete data and accuracy of captured data.

Company's accessibility to external data sources

Given the data shown in Table 4.4 below, whilst a minority (16.7%) of the survey participants disagree with the statement that their organisations have access to data from external sources, 66.6% of the survey participants agree (33.3% strongly agree). The remaining 33.3% prefer to remain neutral as to their organisations' accessibility to external data sources.

Use of automated data capture

As shown in Table 4.4 below, whilst (33.3%) of the survey participants prefer to remain neutral with the statement that their organisations do make use of automated data capture systems, 66.6% of the survey participants agree (33.3% strongly agree).

Consistency of stored data in a database

Regarding the statement about the consistency of stored data in a database, whilst 50% of the participants in the survey agree with the statement that data are being stored across various databases in their organisations, the other 50% of the survey participants prefer to remain neutral as to whether data are being stored across various databases in their organisations.

Concerns with incomplete data

Regarding the concerns about incomplete data, whilst 50% of the participants in the survey agree with the statement that their organisation does not have a problem with incomplete data, another 16,7% disagree with the statement. The remaining 33.3% of the participants prefer to remain neutral

Accuracy of captured data.

Given the data emanating from the survey regarding the accuracy of captured data, as shown in Table 4.4 below, the majority of the participants in the survey agree with the statement concerning the accuracy of captured data in their organisations. However, 16.7% of the participants disagree with the statement. The remaining 16.7% of the participants in the survey prefer to remain neutral.

In this context, the following finding can be concluded from the study: the majority of the participants agree with the statement that their organisation has access to external data sources. Regarding the concern about the use of automated data capture, the majority of the participants agree with the statement that their organisations do make use of automated data sources. That could be considered one of the influencing factors for blockchain adoption. Regarding the concern about the consistency of stored data in a database as an influencing factor for blockchain adoption, the majority of the participants in the survey also agree with the statement. The concern about incomplete data could be a demotivating factor for blockchain adoption. The results emanating from the study demonstrate that the majority of the participants agree with this statement.

It can be deduced from the study that technological benefits of blockchain technology, such as organisational accessibility to data, accuracy,] and consistency of stored data, constitute some of the inducing factors for blockchain adoption in organisations.

The above results agree with the study by Kalaitzi, Jesus and Campelos (2019) on the determinants of blockchain adoption and perceived benefits in food supply chains. According to Kalaitzi, Jesus and Campelos (2019), one of the perceived benefits of blockchain technology is to decrease communication or transfer data errors and fraud. Blockchain technology enables decentralised and immutable storage of verified data.

Table 4.4 Tabular frequency distribution of technology availability

		Count	Column N %
Company's accessibility to external data sources	Disagree	10	16.7%
	Neutral	10	16.7%
	Agree	20	33.3%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Use of automated data capture systems.	Neutral	20	33.3%
	Agree	20	33.3%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Consistency of stored data in database	Neutral	30	50.0%
	Agree	30	50.0%
	Total	**60**	**100.0%**
Concerns with incomplete data	Disagree	10	16.7%
	Neutral	20	33.3%
	Agree	20	33.3%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**
Accuracy of captured data	Disagree	10	16.7%
	Neutral	10	16.7%
	Agree	30	50.0%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**

4.2.2.1.5 Security

Table 4.4 below shows a frequency distribution of the data emanating from the study regarding the perceived compatibility. Data are grouped into four segments namely, data privacy, compliance with technology privacy, management of risks associated with the technology and the existence of security privacy laws on the blockchain.

Data privacy

As shown in Table 4.4 below, whilst (33.3%) of the survey participants prefer to remain neutral with the statement that their organisations can easily ensure data privacy when using blockchain technology, 66.6% of the survey participants agree (33.3% strongly agree).

Compliance with technology privacy

Regarding the concerns about compliance with technology privacy, the majority (67.7%) of the participants in the survey agree with the statement that blockchain technology is compatible with the data used in their respective organisations. The remaining 33.3% prefer to remain neutral

Management of risks associated with the technology

As shown in Table 4.4 below, 50% of the survey participants agree with the statement regarding the management of risks associated with blockchain technology. Thus, the participants agree that their organisations can easily manage the risks associated with blockchain technology. The remaining 50% of the participants prefer to remain neutral.

Existence of security privacy laws on blockchain.

As shown in Table 4.4 below, whilst (16.7%) of the survey participants prefer to remain neutral with the statement regarding the existence of laws that deal with the security and privacy of blockchain technology, majority (66.7%) of the participants agree with the statement of the existence of security privacy laws on blockchain technology. However, 16.7% of the participants disagreed with the statement.

Given the results shown above, it can be seen that the majority of the participants agree with the statement that data privacy is a security factor affecting the adoption of blockchain. For compliance with technology privacy, the majority of participants see technology privacy as a security concern influencing blockchain adoption. The participants equally agree that the management of risks associated with the technology and the existence of security and privacy laws on the blockchain are both factors that affect the adoption of blockchain.

These findings seek to validate the study by Kühn et al. (2019), who argue that the most mentioned perceived benefits of blockchain technology are high data security based on the distributed ledger and transparency. Similarly, Kim and Laskowski argued that blockchain technologies promise to provide extremely secure and immutable access to supply chain data (Kim & Laskowski, 2016). This means that no

authority or participant can alter or manipulate the data stored on the blockchain (Mougayar, 2016).

However, Gordon and Catalini (2018) contest that internal data are very confidential and kept hidden from others. Given this pitfall, organisations may be unwilling to provide information and instead impose severe safeguards (Fawcett, Wallin, Allred & Magnan, 2009).

Table 4.5 : Tabular frequency distribution of perceived security

		Count	Column N %
Data privacy	Neutral	20	33.3%
	Agree	20	33.3%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Compliance with the Technology privacy regulations	Neutral	20	33.3%
	Agree	30	50.0%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**
Management of risks associated with the Technology	Neutral	30	50.0%
	Agree	20	33.3%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**
Existence of security and privacy laws on Block Chain Technology	Disagree	10	16.7%
	Neutral	10	16.7%
	Agree	40	66.7%
	Total	**60**	**100.0%**

4.2.2.2 4.2.2.2 Organisational factors affecting blockchain adoption

Data regarding the organisational factors affecting blockchain adoption were obtained from the participants. The obtained data are grouped into the following categories: organisational size, management support, available resources and IT.

4.2.2.2.1 Size of organisation

Table 4.5 below shows a descriptive statistic of the data emanating from the study regarding the size of organisations as a perceived organisational factor affecting blockchain adoption. In this context, the emanating data from the study are categorised as follows: company geographical spread, adoption of blockchain

technology in the company's department and the use of blockchain technology by an optimum number of employees**.**

Company geographical spread

As shown in Table 4.5 below, whilst the majority (83.3%) of the survey participants agree with the statement that their organisations have more than one location, 16.7% of the participants, however, disagree with the statement. The statement was put forward by the researcher to establish the inducement of the geographical spread of organisations as an organisational factor that could influence the adoption of blockchain technology.

Adoption of blockchain technology in the company's department

Regarding the concerns about the roll out of blockchain technology in all the departments of the organisation, whilst 33.3% of the participants in the survey agree that blockchain is rolled out in all departments of their organisations, another 16,7% disagree with the statement. The remaining 50% of the participants prefer to remain neutral.

Use of blockchain technology by an optimum number of employees

Regarding the statement about the use of blockchain technology by the optimum number of employees in an organisation, 50% of the participants in the survey agree that their organisations have more than 100 employees using blockchain technology. However, the remaining 50% of the participants disagree with the statement, with which 33.3% of the participants strongly disagree.

Drawing from the above data emanating from the study, the majority of the participants agree that their company has more than one location or is geographically spread, which could positively influence their management decision to adopt blockchain technology. Regarding the concern about the adoption of blockchain technology in the company's department, the majority of the respondents prefer to remain neutral as to whether blockchain technology is adopted in all departments in their respective companies or organisations. Similarly, in responding to the statement regarding the

optimum number of employees in participants' respective organisations, the majority of respondents also prefer to remain neutral to the statement.

Given the theoretical foundation of this study, scholars have argued that organisational size has been widely used to predict IT adoption in companies (Clohessy, Acton & Rogers, 2018; Gutierrez et al., 2015; Tapscott & Tapscott, 2016). There is an ongoing debate as to the ease of adoption of new technology between large firms and small firms. Gutierrez et al. (2015) and Schneider (2019) claim that small firms are more likely to adopt blockchain, as they are more flexible given their lower levels of bureaucracy. However, other scholars (Kalaitzi, Jesus & Campelos, 2019) disagree. Some scholars mentioned that only a handful of studies support that large firms have more resources than small firms and can easily take the risk of innovation adoption. Small firms will be laden with the burden of investing in IT infrastructure, new skill development and re-engineering processes, to mention a few.

Table 4.5 : Tabular frequency distribution of perceived organisational factors affecting blockchain adoption

		Count	Column N %
Company's geographical spread	Strongly Disagree	10	16.7%
	Agree	30	50.0%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Adoption of Block Chain Technology in company's departments	Disagree	10	16.7%
	Neutral	30	50.0%
	Agree	20	33.3%
	Total	**60**	**100.0%**
Use of Block Chain Technology by optimum number of employees	Strongly Disagree	20	33.3%
	Disagree	10	16.7%
	Agree	30	50.0%
	Total	**60**	**100.0%**

4.2.2.2.2 Management Support

The data emanating from the study concerning management support are grouped into 5 categories: promoting the use of blockchain, support for blockchain initiatives, comprehending and acknowledging the strategic advantage of blockchain technology, providing required resources to support blockchain technology and enthusiasm about blockchain technology.

Promoting the use of blockchain

As shown in Table 4.5 below, whilst the majority (83.3%) of the survey participants agree with the statement that their top management promotes the use of blockchain in their respective organisations, 16.7% of the participants, however, prefer to remain neutral as to whether their top management promotes the use of blockchain technology in their respective organisations.

Support for blockchain initiatives

Concerning top management support for blockchain initiatives within organisations, while 66.6% of survey participants agree that top management support blockchain initiatives within their organisations, another 16.7% disagree. The remaining 16.7% of the participants prefer to remain neutral.

Comprehending and acknowledging the strategic advantage of blockchain technology.

Concerning top management support for blockchain initiatives within organisations, 66.6% of survey participants agree that top management understands the strategic advantage of blockchain. However, 16.6% of the participants disagree with the statement. Then, 13,3% support blockchain initiatives within their organisations and another 16.7% disagree. The remaining 16.7% of the participants prefer to remain neutral.

Providing required resources to support blockchain technology

Concerning the issue of top management providing resources to support blockchain technology, 66.7% of survey participants agree that top management in their respective organisations does provide the required resources to support blockchain technology. The remaining 33.3% of the participants prefer to remain neutral.

Enthusiastic about blockchain technology

Given Table 4.5 below, the data emanating from the data show that 66.7% of survey participants agree with the statement that top management is enthusiastic about blockchain technology. However, 33.3% of the participants prefer to remain neutral

Given the above findings, it can be deduced that the majority of the participants agree that their top management promotes the use of blockchain technology in their organisation. Regarding top management support for blockchain technology initiatives, the majority of the participants also agree that top management in their organisation supports blockchain technology initiatives. For top management comprehension and acknowledgement of the strategic advantage of blockchain, the majority of participants agree that their top management understands and acknowledges the strategic advantage of blockchain technology. Regarding the top management's provision of resources to support blockchain, findings from the study also indicate that the majority of participants agree that their top management provides resource support to blockchain technology in their respective companies. Lastly, for the question regarding the enthusiasm of top management about blockchain technology, the findings from the study reveal that the majority of the respondents agree that their respective top management are enthusiastic about the technology.

Scholars have widely argued that successful blockchain adoption necessitates extensive organisational support across multiple spectrums (Holotiuk & Moormann, 2019; Kamarulzaman et al., 2021; Wang & Xu, 2016). The study by Wang et al. (2019) identified top management support as a critical iterative factor in the adoption of IT innovations. Holotiuk and Moormann (2019) reason that the support of top management is on a high agenda in this context due to the investment required in the new technology, as managers need to value the technology's potential for things to happen. Swan (2015) galvanises the paramount importance of top management support in this context by mentioning that blockchain adoption can involve new regulatory requirements, which require the exigence of critical managerial decisions. These requirements include the acquisition of new resources, resource integration, the re-imaging of business, information sharing and new skills development.

Table 4.6 : Tabular frequency distribution on management support

		Count	Column N %
Top Management promotion of the use of Block Chain Technology	Neutral	10	16.7%
	Agree	30	50.0%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Top Management support for Block Chain Technology Initiatives	Disagree	10	16.7%
	Neutral	10	16.7%
	Agree	20	33.3%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Top management Comprehend and acknowledge the strategic advantage of Block Chain Technology	Disagree	10	16.7%
	Neutral	10	16.7%
	Agree	20	33.3%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Top Provision of resources by Top Management to support Block Chain Technology)	Neutral	20	33.3%
	Agree	20	33.3%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Level of enthusiasm of top management about the Technology	Neutral	20	33.3%
	Agree	30	50.0%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**

.

4.2.2.2.3 Available Resources

The data emanating from the study concerning management support are grouped into 4 categories: an infrastructural fund to establish blockchain technology, maintenance funding, human resources funding and accessibility to external funding

Infrastructural fund to establish blockchain technology

Given Table 4.6 below, data show that 83.3% of survey participants agree with the statement that their organisations have no difficulty in funding infrastructure to adopt blockchain technology. However, 16.7% of the participants prefer to remain neutral

Maintenance funding

Concerning the issue of financing the ongoing maintenance of blockchain technology, 66.7% of survey participants agree that their organisations have no difficulty in finding staff to adopt blockchain technology. The remaining 16.7% of the participants prefer to remain neutral.

Human resources funding

As shown in Table 4.17 below, whilst 50.0% of the survey participants agree with the statement that their organisations have no difficulty in finding staff to adopt blockchain technology projects, the other 50.0% of the participants prefer to remain neutral as to whether their organisations have no difficulty obtaining bank loans for blockchain technology projects.

Accessibility to external funding

Concerning the issue of obtaining external funding for the adoption of blockchain technology, as shown in Table 4.6 below, whilst the majority (66.6%) of the survey participants prefer to remain neutral, 16.7% agree with the statement that their organisations have no difficulty in obtaining external funding to adopt blockchain technology projects. The remaining 16.7% of the participants disagree.

The results above reveal that the majority of the participants agree that their organisations have no difficulty in funding infrastructure to adopt blockchain technology. Regarding maintenance funding, the findings of the study reveal that participants also agree that their respective organisations have no difficulty financing the ongoing maintenance of blockchain technology. For human resources funding, the majority of respondents believe that their companies will have no trouble funding employees to implement blockchain technology. Lastly, regarding the question of accessibility to external funding, the majority of the participants prefer to remain neutral as to whether their organisation has no difficulty in obtaining bank loans for blockchain technology projects.

Some scholars argued that only a handful of studies support the idea that large firms have more resources than small firms and can more easily take the risk of innovation adoption. Small firms will be laden with the burden of investing in IT infrastructure, new

skill development and re-engineering processes, to mention a few. Swan (2015) galvanises the paramount importance of resources to the successful adoption of blockchain by mentioning that blockchain adoption can involve new regulatory requirements which require the exigence of critical managerial decisions on the acquisition of new resources, resource integration, the re-imaging of business, information sharing and new skills development.

Table 4.7 : Tabular frequency distribution of Available resources

		Count	Column N %
Infrastructural funds to adopt Blockchain Technology	Neutral	10	16.7%
	Agree	40	66.7%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**
Maintenance funding	Neutral	20	33.3%
	Agree	30	50.0%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**
Human resources (staff) funding to adopt Block Chain Technology	Neutral	30	50.0%
	Agree	30	50.0%
	Total	**60**	**100.0%**
Accessibility to external funding (loans) to adopt Block Chain Technology	Disagree	10	16.7%
	Neutral	40	66.7%
	Agree	10	16.7%
	Total	**60**	**100.0%**

4.2.2.2.4 IT Skills

The data emanating from the study concerning IT skills as one of the organisational factors affecting the adoption of blockchain is grouped into 4 categories: support of the company's IT infrastructure, hosting and maintaining the IT infrastructure, support of the company's analytics capabilities and availability of skilled resources.

Support of the company's IT infrastructure

Given Figure 4.18 below, data emanating from the survey show that 83.3% of survey participants agree with the statement that their organisations have no difficulty in funding infrastructure to adopt blockchain technology. However, 16.7% of the participants prefer to remain neutral.

Hosting and maintaining the IT infrastructure

Concerning the issue of hosting and maintaining the IT infrastructure to support blockchain technology, Table 4.18 below shows that 83.3% of survey participants agree with the statement that their organisations have no problem hosting and maintaining the IT infrastructure to support blockchain technology. However, 16.7% of the participants prefer to remain neutral.

Support of the company's analytics capabilities

Concerning the issue of whether a company's analytics capabilities support the adoption of blockchain technology, Table 4.18 below shows that 83.3% of survey participants agree with the statement that their organisations have the analytics capabilities to support the adoption of blockchain technology. However, 16.7% of the participants prefer to remain neutral.

Availability of skilled resources.

Concerning the issue of the availability of skilled resources to support the adoption of blockchain technology, Table 4.18 below shows that 83.3% of survey participants agree with the statement that their organisations have sufficient skilled resources to support the adoption of blockchain technology. However, 16.7% of the participants prefer to remain neutral.

Results from the study demonstrate that the majority of the participants agree that their companies' IT infrastructure supports the adoption of blockchain technology. Regarding the concern about hosting and maintaining the IT infrastructure, the majority of the participants also agree that their companies have no problem hosting and maintaining the IT infrastructure to support blockchain technology. Concerning support of the company's analytics capabilities, majority of participants agree that their companies' analytics capabilities support the adoption of blockchain technology. Lastly, regarding the availability of skilled resources, majority of the participants agree that their company has sufficient skilled resources to support the adoption of blockchain technology.

The importance of the compatibility of existing structures as a strong determinant for the adoption of blockchain was highlighted in the theoretical framework of the study. It was argued that existing infrastructure should be able to support the adoption of blockchain technology. Put simply, the organisational readiness of the firm is of paramount importance. Organisational readiness is perceived as the availability of specific organisational resources for adopting new IT innovations, which, amongst other things, includes the company's existing IT infrastructures and skilled resources (Lindman et al., 2017; Zheng et al., 2018).

Table 4-8: Tabular frequency distribution of IT skills

		Count	Column N %
Support of company's IT infrastructure	Neutral	10	16.7%
	Agree	30	50.0%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Hosting and maintaining the IT infrastructure	Neutral	10	16.7%
	Agree	30	50.0%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Support of company's Analytics capabilities	Neutral	10	16.7%
	Agree	30	50.0%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Availability of skilled resources	Neutral	10	16.7%
	Agree	50	83.3%
	Total	**60**	**100.0%**

4.2.2.3 Environmental factors affecting Blockchain adoption

Data on environmental factors influencing adoption were gathered from respondents/participants. The obtained data were grouped into the following categories: external support, trading partner pressure;and competitive pressure.

4.2.2.3.1 External support

The data emanating from the study concerning external support as environmental factors affecting blockchain adoption are grouped into 4 categories: support of South African policies and laws, incentive provision by the government, privacy and security

provision by South African laws with regards to blockchain and difficulty in meeting legal expectations.

Support of South African policies and laws

Given Table 4.19 below, the data emanating from the survey shows that 50.0% of survey participants agree with the statement that South African policies and laws support the use of blockchain technology in their organisations. However, 16.7% of the participants prefer to remain neutral.

Incentive provision by the government

Concerning the issue of incentive provision by the government, as shown in Figure 4.19 below, the majority (66.6%) of the survey participants agree with the statement that the South African government provides incentives for the adoption of blockchain technology. Whilst 16.7% of the participants disagree with the statement, the remaining 33.3% prefer to be neutral.

Privacy and security provision by South African laws with regards to blockchain

Regarding the issue of privacy and security, as shown in Figure 4.19 below, majority (66.7%) of the survey participants agree with the statement that the South African laws on big blockchain technology protect the privacy and security concerns relating to *blockchain*. Then, 16.7% of the participants prefer to be neutral.

Difficulty in meeting legal expectations.

The results from the study reveal that majority of the participants agree that South African policies and laws support the use of blockchain technology in their respective organisations. Regarding the concerns of incentive provision by the government, majority of the participants also agree that the South African government provides incentives for the adoption of blockchain technology. The majority of participants agree that South African *blockchain* laws protect the privacy and security concerns associated with *blockchain*. Lastly, regarding the question of the difficulties in meeting

legal expectations, the participants also agree that their organisations have no difficulty meeting legal expectations concerning blockchain technology.

Seemingly, the findings from the study corroborate the assertion of Choi et al. (2020) that government backing is critical in increasing the adoption of new technologies. Choi et al. (2020) add that a lack of government support in the form of financing or supportive legislation discourages businesses from exploring adoption. Still on the imperativeness of external support as it relates to policy and legal framework, Kühn et al. (2019) warn that legal uncertainties impede investments in blockchain technology.

Table 4-10: Tabular frequency distribution of perceived environmental factors affecting blockchain adoption

		Count	Column N %
Support of South African policies and laws	Neutral	30	50.0%
	Agree	20	33.3%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**
Incentive provision by the government	Disagree	10	16.7%
	Neutral	20	33.3%
	Agree	20	33.3%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**
Privacy and security protection by South African laws relating to Big Data Analytics	Neutral	20	33.3%
	Agree	30	50.0%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**
Difficulty in meeting legal expectations	Neutral	30	50.0%
	Agree	20	33.3%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**

4.2.2.3.2 Trading Partner Pressure

The data emanating from the study concerning trading partner pressure as environmental factors affecting blockchain adoption are grouped into 5 categories: usage by training partners, provides strategic advantages over partners, pressure from trading partners to use blockchain technology, customers' gains from trading partners and provides trading partners significant advantage.

Usage by trading partners

Regarding the concerns of training partners' pressure as it relates specifically to the blockchain usage by trading partners, the data results, as shown in Figure 4.20 below, demonstrated that the majority (66.6%) of the survey participants agree with the statement that their organisations would use blockchain technology based on whether their trading partners are using it. However, 16.7% of the participants disagree with the statement. The remaining 16.7% prefer to remain neutral.

Provides strategic advantages over partners

Concerning the issues around the provision of strategic advantage by blockchain technology, majority (66.6%) of the survey participants agree with the statement that blockchain technology provides a strategic advantage over their trading partners. However, 16.7% of the participants disagreed with the statement. The remaining 16.7% prefer to remain neutral.

Pressure from trading partners to use blockchain technology

Regarding the concerns of pressure from trading partners to use blockchain technology, 16.7% of the survey participants strongly disagree with the statement that their organisations are under pressure to use blockchain technology by their trading partners. However, majority (83.3%) of the participants prefer to remain neutral as to whether their organisations are under pressure from their trading partners to use blockchain technology.

Customers gains from trading partners

Concerning the issue of possible customer gain from trading partners, the data emanating from the study reveals that majority (66.6%) of the survey participants agree with the statement that blockchain technology would help their organisations gain customers from their trading partners. The remaining 16.7% prefer to remain neutral.

Provides trading partners with significant advantage

The results concerning the ability of blockchain technology to provide trading partners with significant advantages, Table 4.19 below shows that majority (66.6%) of the survey participants agree with the statement that blockchain technology gives their trading partners a significant advantage. The remaining 16.7% prefer to remain neutral.

From the results, it can be deduced that majority of the participants agree that their organisations would use blockchain technology based on whether their trading partners are using it. Regarding the question of whether the technology provides strategic advantages over partners, the participants also agree that blockchain technology gives strategic advantage over trading partners. Concerning the pressure from trading partners to use blockchain technology, majority of participants prefer to be neutral as to whether their companies are under pressure to use blockchain technology by their trading partners. Regarding the question of customer gains from trading partners, the majority of the participants agree that blockchain technology would help them gain customers from their trading partners. Lastly, the concern that blockchain technology provides trading partners a significant advantage, majority of the participants also agree that blockchain technology gives their trading partners a significant advantage.

Drawing from the theoretical framework of this study, it has been argued that a company's adoption of blockchain could provide them with a competitive advantage. Given the perspective of Kshetri (2018), blockchain applications were seen as a means of resolving trust challenges in supply chains. Hence, the enthusiasts of blockchain are thus encouraging early adoption of the technology for their businesses to remain competitive in the market.

Table 4-11: Tabular frequency distribution of perceived training partner pressure

		Count	Column N %
Usage by trading partners	Disagree	10	16.7%
	Neutral	10	16.7%
	Agree	40	66.7%
	Total	**60**	**100.0%**
Provides strategic advantage over trading partners	Disagree	10	16.7%
	Neutral	10	16.7%
	Agree	20	33.3%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Pressure from trading partners to use block chain Technology	Disagree	10	16.7%
	Neutral	50	83.3%
	Total	**60**	**100.0%**
Customer gains from trading partners	Neutral	20	33.3%
	Agree	30	50.0%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**
Provides trading partners significant advantage	Neutral	20	33.3%
	Agree	30	50.0%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**

4.2.2.3.3 Competitive pressure

The data emanating from the study concerning competitive pressure as environmental factors affecting blockchain adoption are grouped into 5 categories: usage influence by competitors, provision of strategic advantage over our competitors, company under pressure to use blockchain technology by competitors, gaining customers from our competitors and providing competitors a significant advantage

Usage influence by competitors

Regarding the concerns of competitors' pressure, specifically, as it relates to the usage of blockchain possibly being influenced by competitors, the data results, as shown in Table 4.21 below, demonstrated that the majority (50.0%) of the survey participants agree with the statement that their organisations would use blockchain technology based on whether their trading competitors are using it. However, 16.7% of the

participants disagreed with the statement. The remaining 33.3% prefer to remain neutral.

Provision of strategic advantage over our competitors

Concerning the issue around the provision of strategic advantage over competitors by blockchain technology, majority (66.6%) of the survey participants agree with the statement that blockchain technology provides a strategic advantage over their competitors. However, 33.3% of the participants prefer to remain neutral

Company under pressure to use blockchain technology by competitors

Regarding the concerns about organisation under pressure by competitors to use blockchain technology, as shown in Table 4.21 below, the results demonstrated that 16.7% of the survey participants strongly disagree with the statement that their organisations are under pressure by competitors to use blockchain technology by their trading partners. However, the majority (83.3%) of the participants prefer to remain neutral as to whether their organisations are under pressure from their competitors to use blockchain technology.

Gaining customers from our competitors

Concerning the issue of possible customer gain competitors, data emanating from the study reveals that majority (66.6%) of the survey participants agree with the statement that blockchain technology would help their organisations gain customers from their competitors. The remaining 33.3% prefer to remain neutral.

Provide competitors a significant advantage

The results of data concerning the ability of blockchain technology to provide competitors with significant advantages, as depicted in Table 4.21 below, show that majority (50.0%) of the survey participants prefer to remain neutral. However, 33.3% and 16.7% of the participants agree and disagree, respectively, with the statement that blockchain technology provides their competitors a significant advantage.

The results from the study reveal that the majority of the participants agree that their organisations would use blockchain technology based on whether their competitors are using it. Regarding the concern of whether blockchain technology provides organisations with a strategic advantage over their competitors, the participants agree it provides their organisations with a strategic advantage over their competitors. When it comes to the concern about whether organisations are under pressure to use blockchain technology by competitors, majority of the participants prefer to be neutral as to whether their companies are under pressure to use blockchain technology by their competitors. Furthermore, on the statement as to whether blockchain technology would help companies gain customers from competitors, the majority of the participants agreed that blockchain technology would help them gain customers from their competitors. Lastly, given the question as to whether blockchain technology gives companies' competitors a significant advantage, majority of the respondents prefer to remain neutral as far as the latter statement is concerned.

As seen in the study done by Kamarulzaman et al. (2021) on factors affecting blockchain adoption by government organisations, the market dynamics support factor has a significant positive influence on blockchain adoption. Kamarulzaman et al. (2021) referr to market dynamics supporting the rapidly changing blockchain technological landscape that forces organisations to review their existing business processes in order to assess how blockchain can be used as a technology differentiator, which could assist them with customers from their competitors. However, Clohessy et al. (2018) stated that how the incumbents and the new players divide the market and who provides the services that the consumers are willing to accept and adopt remain to be seen.

Table 4-12: Tabular frequency distribution of perceived competitive pressure

		Count	Column N %
Usage influence by competitors	Disagree	10	16.7%
	Neutral	20	33.3%
	Agree	20	33.3%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**
Provision of strategic advantage over our competitors	Neutral	20	33.3%
	Agree	20	33.3%
	Strongly Agree	20	33.3%
	Total	**60**	**100.0%**
Company being under pressure to use Blockchain Technology by competitors.	Strongly Disagree	10	16.7%
	Neutral	50	83.3%
	Total	60	100.0%
Gaining customers from our competitors	Neutral	20	33.3%
	Agree	40	66.7%
	Total	**60**	**100.0%**
Provides competitors a significant advantage	Strongly Disagree	10	16.7%
	Neutral	30	50.0%
	Agree	20	33.3%
	Total	**60**	**100.0%**

4.2.2.3.4 Government regulation

Data were obtained from the participants regarding the perceived influence of government regulations on the adoption of blockchain technology. The obtained data was grouped into the following 4 categories: support of the South African policies and laws, government incentives for blockchain adoption, laws on *blockchain* protecting privacy and security and meeting legal expectations regarding blockchain technology.

Support of South African policies and laws

As shown in Table 4.22 below, 50.0% of the participants in the survey agree with the statement that South African policies and laws support the use of blockchain technology in their organisations. The remaining 50.0% of the participants in the survey prefer to remain neutral.

Government incentive for blockchain adoption

The results concerning the provision of government incentives for blockchain technology adoption, as depicted in Table 4.22 below, show that majority (50.0%) of the survey participants prefer to remain neutral. However, 33.3% and 16.7% of the participants agree and disagree, respectively, with the statement that South African policies and laws support the use of blockchain technology in their organisations

Laws on blockchain protecting privacy and security

Regarding the South African laws on *blockchain* with respect to the protection of privacy and security concerns relating to blockchain technology, 50.0% agree, and the remaining 50.0% of the participants prefer to remain neutral.

Meeting legal expectations regarding blockchain technology

Concerning the ability of organisations to meet legal expectations with regard to blockchain technology, the results show that 50.0% of the participants in the survey agree with the statement that their organisations have no difficulty meeting legal expectations concerning blockchain technology. However, the remaining 50.0% prefer to remain neutral.

Given the study's results regarding government support and regulation of blockchain technology, the findings show that the participants agree that South African policies and laws support blockchain technology in their respective organisations. Regarding the consideration of government incentive support for blockchain technology adoption, the majority of the participants prefer to remain neutral. However, some of the participants agree with the statement that the government provides incentive support for blockchain technology adoption in organisations. Regarding the concerns of government laws on *blockchain* with regards to the protection of privacy and security, the participants also agree that South African laws on *blockchain* protect the privacy and security concerns relating to blockchain technology. Regarding the question of meeting legal expectations concerning blockchain technology, 50 percent of the participants agree that their companies have no difficulty meeting legal expectations concerning blockchain technology.

The above results highlight the crucial role of the government regarding the enactment and implementation of policies and regulatory frameworks, especially as it relates to privacy and security regarding the adoption of blockchain technology. According to Clohessy et al. (2018), the regulatory environment for blockchain is projected to include governments that must review and address a variety of related issues, such as consumer protection, financial integrity and a lack of distributed ledger technology-specific legislation.

Table 4-13: Tabular frequency distribution of perceived government regulation

		Count	Column N %
Support of South African policies and laws	Neutral	30	50.0%
	Agree	20	33.3%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**
Government provides incentives for the adoption of Blockchain Technology	Disagree	10	16.7%
	Neutral	30	50.0%
	Agree	20	33.3%
	Total	**60**	**100.0%**
South African laws on Big Data Analytics protect the privacy and security	Neutral	30	50.0%
	Agree	20	33.3%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**
Meeting legal expectations concerning Blockchain Technology	Neutral	30	50.0%
	Agree	20	33.3%
	Strongly Agree	10	16.7%
	Total	**60**	**100.0%**

4.2.3 Analysis of Variance (ANOVA) of TOE Constructs

The researcher carried out an analysis of the variance of the TOE Framework constructs comprising techtotal, orgtotal and envirototal based on the study's demographic data. The emanating results and the corresponding inferences drawn from the results are presented below.

Age

The statistical results of the variance analysis of the TOE construct based on the age groups of the participants are shown in Table 4.1 below. The statistical results show that there is a significant difference in opinions between the groups when we look at the construct, TOE. Given their p-values, there is a significant difference in the opinions of the participants based on age group. While the technology total (p = 0.000) and organisation total (p = 0.000) are significant, the environment total is not significant (NaN).

Table 4-1: ONEWAY /VARIABLES= Techtotal Orgtotal envirototal BY Age /POSTHOC=LSD.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Techtotal	**Between Groups**	7648,33	4	1912,08	584,25	,000
	Within Groups	180,00	55	3,27		
	Total	7828,33	59			
Orgtotal	**Between Groups**	2060,00	4	515,00	39,34	,000
	Within Groups	720,00	55	13,09		
	Total	2780,00	59			
Envirototal	**Between Groups**	3200,00	4	800,00	-5E+016	NaN
	Within Groups	,00	55	,00		
	Total	3200,00	59			

Given the results from the analysis in this context, it can be deduced that different age groups may exhibit varying perceptions of technological complexity, compatibility, and availability (Techtotal). Younger age groups, who have grown up in the digital age, may have a higher comfort level with technology and perceive it as less complex. They may also be more open to adopting new technologies and perceive them as compatible with their existing technological environment. Older age groups may have different perceptions, potentially considering technology as more complex or facing challenges with compatibility due to limited exposure or familiarity. Understanding these differences is crucial for tailoring communication and training approaches to address the specific needs and preferences of each age group.

Regarding the organisational construct (Orgtotal), top management support and promotion are essential for successful blockchain adoption within an organisation. Their vision, resource allocation, change management efforts, collaboration, knowledge, and incentive systems all contribute to creating a supportive environment

that fosters the effective implementation of blockchain technology. Through their leadership and commitment, top management can drive the organization towards embracing the transformative potential of blockchain and reaping its benefits.

As shown in the results, there was no significance level of differences between the different age groups for the environment construct (Envirototal). Seemingly, the different age groups in the study may not have varying experiences and perceptions of environmental factors such as greater exposure to external support networks, government regulations, competitive pressures, and trading partner pressures related to blockchain adoption.

Position

A comparison of the different groups of participants in the survey was carried out based on their different positions in their various organisations. As shown in Figure 4.2 below, the results reveal a significant level of differences between the groups, as manifested in the p-values of all the variables being less than 0.05.

Table 4-2: ONEWAY /VARIABLES= Techtotal Orgtotal envirototal BY Position /POSTHOC=LSD.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Techtotal	**Between Groups**	7108,33	4	1777,08	135,75	,000
	Within Groups	720,00	55	13,09		
	Total	7828,33	59			
Orgtotal	**Between Groups**	2600,00	4	650,00	198,61	,000
	Within Groups	180,00	55	3,27		
	Total	2780,00	59			
envirototal	**Between Groups**	3120,00	4	780,00	536,25	,000
	Within Groups	80,00	55	1,45		
	Total	3200,00	59			

The results reveal a significant level of differences between the groups in relation to positions. Different positions within an organisation may influence perceptions of technological factors. Higher-level positions, with greater exposure to technology strategy and decision-making, may have individuals who perceive technology as less complex and more compatible due to their involvement in shaping technology adoption

within the organisation. In contrast, lower-level positions may have individuals who perceive technology as more complex or face challenges with compatibility due to limited decision-making authority or exposure to technology planning and implementation. Hence the differences in perceptions between the groups

Regarding the Orgtotal, it results portrays different positions within an organisation have varying levels of decision-making authority. Positions at higher levels of management or leadership have greater influence over strategic decisions, resource allocation, and organizational initiatives. Therefore, individuals in such positions may have more power to support and promote blockchain adoption compared to those in lower-level positions.

Similarly. different positions within an organization may affect perceptions and experiences related to external support, government regulation, competitive pressure, and trading partner pressure. Higher-level positions often have more exposure to external support networks, involvement in regulatory compliance, and decision-making authority to navigate competitive and trading partner pressures. In contrast, lower-level positions may have limited exposure or influence in these areas. These differences in position can impact the perceived importance and influence of these environmental factors on blockchain adoption.

Duration at the company

The researcher did an ANOVA on the duration of employees in the company. The results are found to be significant (.000), as shown in Table 4.3 below. It was found that there is a significant difference in opinions between the groups on Techtotal, which is 0,000, the same with Orgtotal, 0,002 and envirototal 0,000. The results are found to be significant, meaning that there is a difference between the group of employees in relation to their duration in the company.

Table 4-3: ONEWAY /VARIABLES= Techtotal Orgtotal envirototal BY Durationatthecompany /POSTHOC=LSD.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Techtotal	**Between Groups**	3016,67	2	1508,33	17,87	,000

		Sum of Squares	df	Mean Square	F	Sig.
	Within Groups	4811,67	57	84,42		
	Total	7828,33	59			
Orgtotal	**Between Groups**	540,00	2	270,00	6,87	,002
	Within Groups	2240,00	57	39,30		
	Total	2780,00	59			
envirototal	**Between Groups**	1920,00	2	960,00	42,75	,000
	Within Groups	1280,00	57	22,46		
	Total	3200,00	59			

The duration of the company often correlates with its level of maturity and establishment of the employees in the company. Employees with longer durations are more likely to acquainted with organisational established processes, structures, and systems in place, which can impact their willingness and ability to adopt new technologies like blockchain. Employees with longer duration may face challenges in embracing disruptive technologies due to existing legacy systems or resistance to change, resulting in potentially lower levels of support and promotion for blockchain adoption. Hence there is a difference between the group of employees in relation to their duration in the company

Education

The analysis of variance was carried out using the TOE framework as per the educational level of the participants. As shown in Table 4.4 below, the technology total is not significant (0,284 bigger than 0,05); the organisation total is significant (0,043), and the environment total is just on the margin.

Table 4-4: ONEWAY /VARIABLES= Techtotal Orgtotal envirototal BY Educational level /POSTHOC=LSD.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Techtotal	**Between Groups**	338,33	2	169,17	1,29	,284
	Within Groups	7490,00	57	131,40		
	Total	7828,33	59			
Orgtotal	**Between Groups**	290,00	2	145,00	3,32	,043
	Within Groups	2490,00	57	43,68		
	Total	2780,00	59			
envirototal	**Between Groups**	320,00	2	160,00	3,17	,050
	Within Groups	2880,00	57	50,53		

		Sum of Squares	df	Mean Square	F	Sig.
	Total	3200,00	59			

Seemingly in this context, education levels have no impact on individuals' understanding and perceptions of technological factors as revealed in the study.
Higher levels of education may also indicate a higher propensity for learning and adapting to new technologies, potentially leading to greater support and promotion for blockchain adoption. Hence there is differences of opinions between different groups with regards to support and promotion for blockchain adoption.
Similarly, education levels can also impact individuals' understanding and perceptions of environmental factors. Higher education levels may contribute to a deeper comprehension of external support networks, government regulations, competitive pressures, and trading partner pressures related to blockchain adoption. Individuals with higher education levels may have more access to resources, networks, and information that influence their perceptions and experiences regarding these environmental factors.

Blockchain experience

Regarding the blockchain experience of the company of the various participants, a comparison was carried out to determine whether there was a difference between the groups. As shown in Figure 4.4 below, the statistical results reveal that there is a difference between the groups for the technology total (p = 0.000) and organisation total (p = 0.000). The NaN reported for the environment total could be due to few responses.

Table 4-5: ONEWAY /VARIABLES= Techtotal Orgtotal envirototal BY Bigdataexperience /POSTHOC=LSD.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Techtotal	**Between Groups**	7468,33	3	2489,44	387,25	,000
	Within Groups	360,00	56	6,43		
	Total	7828,33	59			
Orgtotal	**Between Groups**	1935,00	3	645,00	42,75	,000
	Within Groups	845,00	56	15,09		
	Total	2780,00	59			

		Sum of Squares	df	Mean Square	F	Sig.
envirototal	**Between Groups**	3200,00	3	1066,67	-7E+016	NaN
	Within Groups	,00	56	,00		
	Total	3200,00	59			

Individuals with blockchain experience may have a better understanding of technical factors related to complexity, compatibility, and availability. Their experience with data management and analysis can contribute to perceiving technology as less complex and more compatible. Additionally, blockchain professionals may have insights into the availability of technology resources and infrastructure, leading to a perception of greater availability. Their expertise can enhance the organization's understanding of technological factors and contribute to effective blockchain adoption strategies.
blockchain experience can be valuable in the context of blockchain adoption, as it involves managing and analyzing large volumes of data. Professionals with blockchain expertise can leverage their skills to handle the data generated by blockchain networks, extract insights, and enhance decision-making related to blockchain adoption. Their experience can contribute to the effective management of blockchain data and the integration of blockchain technology with existing blockchain infrastructure.

Location province

Given the statistical data results emanating from the analysis of variance in the context of location, only orgtotal is found to be significant, as shown in Table 4.6 below. It means that regarding the organisation variable, there seems to be differences among the employees in different locations as to how they perceive organisational factors as influencing parameters for blockchain adoptions by their respective organisations.

Table 4-6: ONEWAY /VARIABLES= Techtotal Orgtotal envirototal BY LocationProvince /POSTHOC=LSD.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Techtotal	**Between Groups**	163,33	1	163,33	1,24	,271
	Within Groups	7665,00	58	132,16		
	Total	7828,33	59			

		Sum of Squares	df	Mean Square	F	Sig.
Orgtotal	**Between Groups**	907,50	1	907,50	28,11	,000
	Within Groups	1872,50	58	32,28		
	Total	2780,00	59			
envirototal	**Between Groups**	120,00	1	120,00	2,26	,138
	Within Groups	3080,00	58	53,10		
	Total	3200,00	59			

Number of employees

Table 4.7 below shows the results emanating from the variance analysis of TOE construct analysis of variance. All the observed variables are found to be significant.

Table 4-7: ONEWAY /VARIABLES= Techtotal Orgtotal envirototal BY Number of employees/POSTHOC=LSD.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Techtotal	**Between Groups**	5801,67	1	5801,67	166,03	,000
	Within Groups	2026,67	58	34,94		
	Total	7828,33	59			
Orgtotal	**Between Groups**	960,00	1	960,00	30,59	,000
	Within Groups	1820,00	58	31,38		
	Total	2780,00	59			
envirototal	**Between Groups**	2666,67	1	2666,67	290,00	,000
	Within Groups	533,33	58	9,20		
	Total	3200,00	59			

As revealed in the study, the duration of the company can impact perceptions of technological factors. Longer-established companies may have legacy systems or established processes, potentially leading to differing perceptions of complexity and compatibility. Companies with longer durations may have more mature technology infrastructure, resulting in perceived availability. Younger companies may exhibit different perceptions based on their agility and openness to embracing new technologies. Understanding the impact of company duration helps tailor approaches to address specific challenges and promote blockchain adoption accordingly.

The company that has adopted blockchain

The statistical results from the analysis (ANOVA) regarding the number of companies that have used blockchain technology show a significant level for all the observed variables, as shown in Table 4.8 below (technology total, organisation total, environment total, all being 0,000).

Table 4-8: ONEWAY /VARIABLES= Techtotal Orgtotal envirototal BY Numberofcompanythatadoptedblockchain/POSTHOC=LSD

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Techtotal	**Between Groups**	6600,83	1	6600,83	311,89	,000
	Within Groups	1227,50	58	21,16		
	Total	7828,33	59			
Orgtotal	**Between Groups**	1920,00	1	1920,00	129,49	,000
	Within Groups	860,00	58	14,83		
	Total	2780,00	59			
envirototal	**Between Groups**	1920,00	1	1920,00	87,00	,000
	Within Groups	1280,00	58	22,07		
	Total	3200,00	59			

Gender

As shown in Table 4.9 below, the statistical results from ANOVA reveal a higher p-value of greater than 0.05, not significant, meaning that there are no differences in opinions between the groups based on gender.

Table 4-9: ONEWAY /VARIABLES= Techtotal Orgtotal envirototal BY Gender /POSTHOC=LSD.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Techtotal	**Between Groups**	3,33	1	3,33	,02	,876
	Within Groups	7825,00	58	134,91		
	Total	7828,33	59			
Orgtotal	**Between Groups**	187,50	1	187,50	4,19	,045
	Within Groups	2592,50	58	44,70		

		Sum of Squares	df	Mean Square	F	Sig.
	Total	2780,00	59			
envirototal	**Between Groups**	120,00	1	120,00	2,26	,138
	Within Groups	3080,00	58	53,10		
	Total	3200,00	59			

Based on the Technology-Organisation-Environment (TOE) framework, the overall conclusions from the ANOVA tests provide insights that are particularly relevant to understanding blockchain adoption within the TOE context. The ANOVA results help identify the impact of technology-related factors, such as complexity, compatibility, and availability, on organizational support and promotion for blockchain adoption. Understanding the significant differences between groups based on these factors allows organizations to assess the technological challenges and opportunities associated with blockchain adoption. It helps in tailoring strategies to address the perceived complexity, improve compatibility with existing systems, and ensure the availability of necessary technological resources for successful blockchain adoption.

4.2.4 Reliability

The researcher uses a reliability test to ascertain that the data are fit to measure what they are supposed to measure. Cronbach's Alpha is utilised to test for reliability. For the construct (Techtotal), 20 observed items are tested, and the Alpha value is 0,96. Regarding the alpha values for the 20 observed variables in the techtotal construct, the minimum is 0,95, and the maximum is 0,96. According to the results, the observed items have good reliability and internal consistency, as all the alpha values are more than 0,60, as shown in Table 4.10 below.

Table 4-10: Table 1 Cronbach's alpha coefficient

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable

0.6 > α ≥ 0.5	Poor
0.5 > α	Unacceptable

Table 4-11: Reliability statistics_Techtotal

Cronbach's Alpha	N of Items
0,96	20

Regarding the alpha values for the 16 observed variables in the orgtotal construct, the minimum is 0,88 and the maximum is 0,70, as shown in Table 4.11 below.

Table 4-12: Reliability statistics_Orgtotal

Cronbach's Alpha	N of Items
0,81	16

Regarding the alpha values for the 17 observed variables in the orgtotal construct, the minimum is 0,92, and the maximum is 0,88, as shown below in Table 4.13.

Table 4-13: Reliability statistics_envirototal

Cronbach's Alpha	N of Items
0,90	17

4.2.5 Correlation

The researcher tests for a relationship between the variables through a Pearson 2-tailed test. The researcher does a correlation on the constructs, which are techtotal, orgtotal and envirototal. The emanating results reveal a strong positive relationship between the constructs. As shown in Figure 4.14, techtotal has a strong positive coefficient (0,862) and a significance p-value (p =0,000); orgtotal has a strong positive coefficient (0,617) and a significance p-value (p=0,000). Envirototal has a strong

positive coefficient (0,919 and a significance p-value (p=0,000). The results show that there is a strong positive relationship between technological and organisational constructs, as well as between technology and environmental constructs.

Table 4-14: **Constructs Correlation Results**

		Techtotal	Orgtotal	envirototal
Techtotal	**Pearson Correlation**	1,000	,862	,919
	Sig. (2-tailed)		,000	,000
	N	60	60	60
Orgtotal	**Pearson Correlation**	,862	1,000	,617
	Sig. (2-tailed)	,000		,000
	N	60	60	60
envirototal	**Pearson Correlation**	,919	,617	1,000
	Sig. (2-tailed)	,000	,000	
	N	60	60	60

4.3 Chapter Summary

The chapter has presented and discussed the results emanating from the data collection used in this study. Specifically, a descriptive and inferential statistical analysis of the data was carried out. The descriptive process was utilised to produce a preliminary summary of the data, and ANOVA and Pearson correlation analysis was done to compare and determine the relationships between the data, respectively. To test for reliability of data, Cronbach's Alpha test was done to achieve the objective of the reliability of data. The results were grouped into four main categories namely, the demographic characteristics of the participants and the technological, organisational and environmental factors influencing the adoption of blockchain. It was revealed in the study that there are specific technological, organisational, and environmental factors that influence the organisational choices for the adoption of blockchain technology. The next chapter presents the conclusions and recommendations.

5. CHAPTER 5 - CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Chapter Five presents conclusions and recommendations for further research. These conclusions and recommendations were facilitated by the discussions that were carried out in Chapter Four and the findings of the study. The objective of this research is to investigate the factors affecting the adoption of blockchain in logistics in South Africa. In this chapter, the researcher concludes and makes recommendations based on the findings, perspectives and expressions of employees on factors affecting the adoption of blockchain technology. Furthermore, the recommendations of this study are based on the research questions and objectives of the study, which are aimed at understanding factors affecting the adoption of blockchain in logistics in South Africa

Specifically, the objectives of this study were to:

- To identify technological factors affecting the adoption of blockchain technology in logistics in South Africa.
- To identify organisational factors affecting the adoption of blockchain technology in logistics in South Africa.
- To identify environmental factors affecting the adoption of blockchain technology in logistics in South Africa.

RO1: To identify technological factors affecting the adoption of blockchain technology in logistics in South Africa.

The key findings from the study regarding the technological factors affecting the adoption of blockchain by organisations are: perceived benefits, perceived complexity, perceived compatibility, technological availability and security.

Perceived benefits

The study has demonstrated that the decision to adopt or not to adopt blockchain technology is influenced by the perceived benefits of the technology. These findings seemingly substantiate the scholarship of Kühn et al. (2019), who argue that the most mentioned perceived benefits of blockchain technology are high data security based on the distributed ledger and transparency. Kim and Laskowski (2019) argued that blockchain technologies promise to provide extremely secure and immutable access to supply chain data (Kim & Laskowski, 2016). As seen in the study, organisations consider these benefits as a strong determinant in making decisions whether to adopt or not to adopt new technology.

Perceived complexity

In this context, the theoretical framework of the study seems to corroborate with the study's findings. Jabbar et al. (2020) suggest that one of the technical challenges to be addressed before the mass adoption of blockchain would be the major challenges of scalability and interoperability.

Perceived compatibility

The study has shown the imperativeness of compatibility on the decisions of organisations not to adopt blockchain technology. According to Mogogole and Jokonya (2018), existing technology factors need to be considered when change management is implemented. Existing technology could refer to IT heritage, inherited IT structure and past successes and failures in IT (Mogogole & Jokonya, 2018). Similarly, Mogogole and Jokonya (2018) argue that the culture of the organisation, as

reflected in its morals, values, views and beliefs, stimulates the innovative behaviours of the staff in the organisation that can bring about change.

Technological availability

The key findings of the study agree with the study by Kalaitzi, Jesus and Campelos (2019) on the determinants of blockchain adoption and perceived benefits in food supply chains. According to Kalaitzi, Jesus and Campelos (2019), one of the perceived benefits of blockchain technology is to decrease communication or transfer data errors and fraud. Blockchain technology enables decentralised and immutable storage of verified data.

Security

Regarding the issue of security, the study's findings seek to validate the study by Kühn et al. (2019), who argue that the most mentioned perceived benefits of blockchain technology are high data security based on the distributed ledger and transparency. Similarly, Kim and Laskowski claim that blockchain technologies promise to provide extremely secure and immutable access to supply chain data (Kim & Laskowski, 2016). This means that no authority or participant can alter or manipulate the data stored on the blockchain (Mougayar, 2016).

RO2: To identify organisational factors affecting the adoption of blockchain technology in logistics in South Africa.

The key findings from the study regarding the organisational factors affecting blockchain adoption are grouped into the following categories: organisational size, management support, available resources and IT.

Organisational size

One of the key findings from the study was organisation size as a determinant for blockchain adoption by organisations. In corroboration with the theoretical foundation of this study, scholars have argued that organisational size has been widely used to

predict IT adoption in companies (Clohessy, Acton & Rogers, 2018; Gutierrez et al., 2015; Tapscott & Tapscott, 2016). There is an ongoing debate as to the ease of adoption of new technology between large firms and small firms. Gutierrez et al. (2015) and Schneider (2019) contend that small firms are more likely to adopt blockchain as they are more flexible given their lower levels of bureaucracy.

Management support

Scholars have widely argued that successful blockchain adoption necessitates extensive organisational support across multiple spectrums (Holotiuk & Moormann, 2019; Kamarulzaman et al., 2021; Wang, Chen & Xu, 2016). The study by Wang et al. (2019) identify top management support as a critical iterative factor in the adoption of IT innovations. Holotiuk and Moormann (2019) reason that the support of top management is on high agenda in this context due to the investment required in the new technology, as managers need to value the technology's potential for things to happen

Resources

Some scholars have argued that only a handful of studies support the idea that large firms have more resources than small firms and can more easily take the risk of innovation adoption. Small firms will be laden with the burden of investing in IT infrastructure, new skill development and re-engineering processes, etcetera. Swan (2015) galvanises the paramount importance of resources to the successful adoption of blockchain by mentioning that blockchain adoption can involve new regulatory requirements, which require the exigence of critical managerial decisions on the acquisition of new resources, resource integration, the re-imaging of business, information sharing and new skills development.

IT

The study has revealed the importance of the compatibility of existing structures as a strong determinant for the adoption of blockchain, as highlighted in the theoretical framework of the study. It was argued that existing infrastructure should support the adoption of blockchain technology. Put simply, the organisational readiness of the firm

is of paramount importance. Organisational readiness is perceived as the availability of specific organisational resources for adopting new IT innovations, which, amongst other things, includes the company's existing IT infrastructures and skilled resources (Lindman et al., 2017; Zheng et al., 2018).

RO3: To identify environmental factors affecting the adoption of blockchain technology in logistics in South Africa.

The key finding on environmental factors influencing adoption are grouped into the following categories: external support, trading partner pressure and competitive pressure.

External support

The findings from the study corroborate the assertion of Choi et al. (2020) that government backing is critical for increasing the adoption of new technologies. Choi et al. (2020) add that a lack of government support in the form of financing or supportive legislation discourages businesses from exploring adoption. Still on the imperativeness of external support, as it relates to policy and legal framework, Kühn et al. (2019) warn that legal uncertainties tend to impede investments in blockchain technology.

Trading partner pressure

The study has demonstrated the important role of trading partner pressure as a deterministic factor for blockchain adoption by the organisation. Drawing from the theoretical framework of this study, it has been argued that a company's adoption of blockchain could provide them with a competitive advantage. Given the perspective of Kshetri (2018), blockchain applications were seen as a means of resolving trust challenges in supply chains. Hence, the enthusiasts of blockchain are encouraging early adoption of the technology for their businesses to remain competitive in the market.

Competitive pressure

In this context, the study's key findings seem to align with the study done by Kamarulzaman et al. (2021) on factors affecting blockchain adoption in government organisations. Given the findings of the study, the market dynamics support factor has a significant positive influence on blockchain adoption. Kamarulzaman et al. (2021) refer to market dynamics supporting the rapidly changing blockchain technological landscape that force organisations to review their existing business processes in order to assess how blockchain can be used as a technology differentiator, which could assist them with customers from their competitors. However, Clohessy et al. (2018) state how the incumbents and the new players divide the market and who provides the services that the consumers are willing to accept and adopt remain to be seen.

Government regulations

The study has revealed the crucial role of the government regarding the enactment and implementation of policies and regulatory frameworks, especially as it relates to privacy and security regarding the adoption of blockchain technology. According to Clohessy et al. (2018), the regulatory environment for blockchain is projected to include governments that must review and address a variety of related issues, such as consumer protection, financial integrity and a lack of distributed ledger technology-specific legislation.

5.2 How has the study achieved its objectives?

Given the above objectives of the study, the key findings emanating from it (theoretical and empirical) have been synthesised into a TOE framework (Figure 5.1), with three dimensions namely, technology, organisation and environment. The framework presents the main categories that were deductively identified in the study as relevant for the adoption of blockchain. The study conducted an ANOVA test to determine if there was a statistically significant difference in opinion between the groups of participants. The study carried out an analysis of the variance of the TOE construct, comprising of technology total, organisation total, and environment total, all this based on the study's demographic data. The statistical results demonstrated that there was a significant difference between the groups. The researcher also did a reliability test to ascertain that the data were fit to measure what it was supposed to measure. Cronbach's Alpha was utilised to test for reliability. Given the statistics, the observed

items had good reliability and internal consistency. Lastly, the researcher also tested for a relationship between the variables using the Pearson 2-tailed test. The statistical results demonstrated a strong positive relationship between the constructs.

Technological factors

The technological perspective includes technological considerations, such as perceived benefits, perceived compatibility, perceived complexity, technology availability and IT security that are being considered for the adoption of new technology. Perceived benefits or the relative advantage to be derived by firms by adopting blockchain technology (-/+), as in the framework below, can well be interpreted as both a motivating and demotivating factor. This should be motivating in the sense that the relative advantage should be seen as significant and assist the organisation's management in making an informed decision on whether or not to adopt blockchain technology. The perceived compatibility of the new technology to the architecture of the existing IT infrastructures, IT skills and data usage constitute other key findings emanating from this study. Moreover, it was revealed in the study that the availability of technology in the organisation plays an influential role in the adoption of blockchain technology. Of most importance, the available technology should be compatible with the existing technology in the organisation. Concerning the dynamics of perceived complexity, the findings of the study reveal a neutral result as to the influence of perceived complexity on the adoption of blockchain technology.

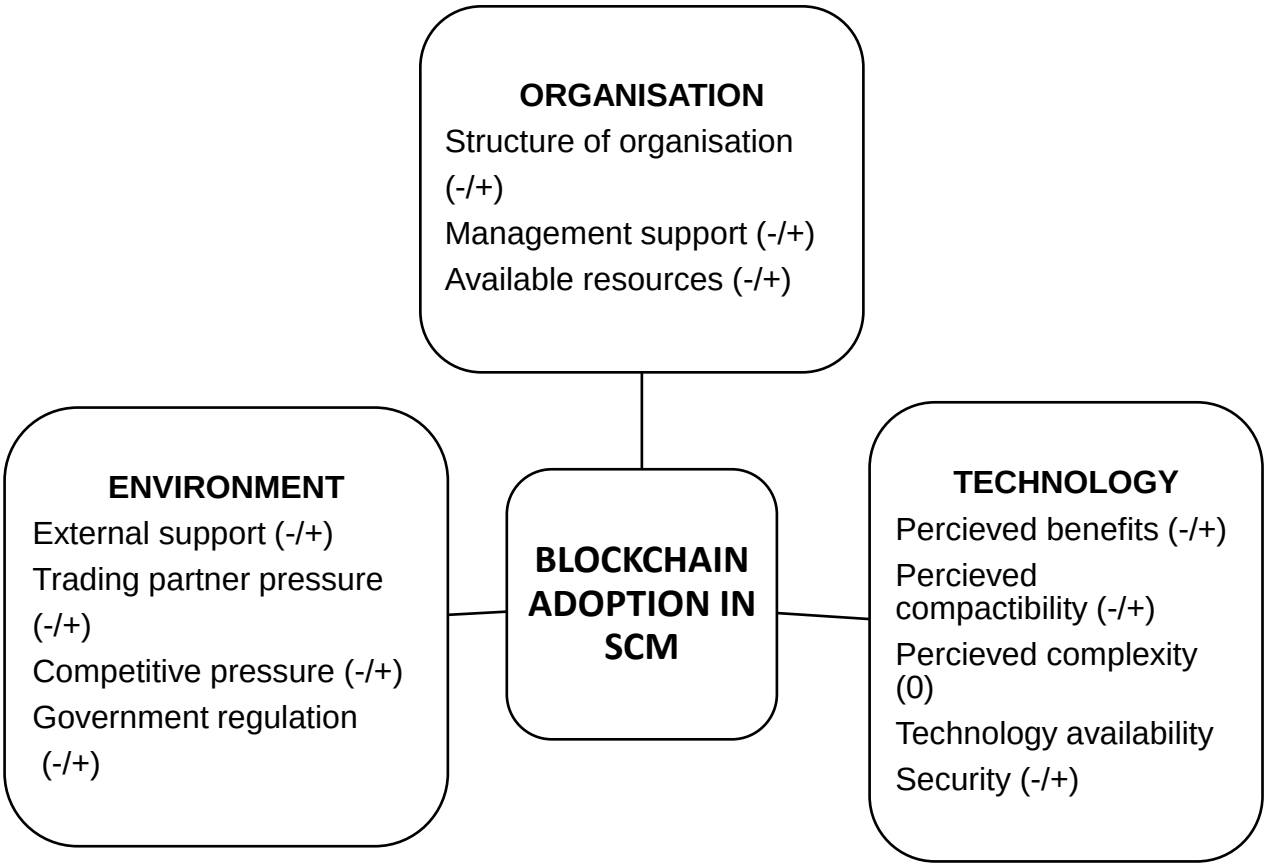
Organisational factors

The adoption of blockchain relies on people knowledgeable about blockchain and able to work in the business functions or IT units to design use cases and develop prototypes. The right people must be identified and enabled to support the adoption. The type of resources required to enhance the adoption of both infrastructure and IT skills must be available. As indicated in the framework below (--/+), the absence of the mentioned requisites will prevent the adoption of blockchain technology by firms.

Environmental factors.

Similar to the organisational context, certain factors present in the environment in which organisations are situated tend to influence the adoption of blockchain by organisations. Since blockchain can hardly be adopted by one firm alone, several dependencies on consortia, technology providers and regulatory bodies exist. Given the findings of this study, external support in the form of government incentives is required to promote the adoption of blockchain technology. Government regulations regarding policies and legal frameworks concerning *blockchain* with regards to the protection of privacy and security are required to promote the adoption of blockchain technology by firms in South Africa. Moreover, the competitive pressure factor is another one to be reckoned with in this context. The findings of this study have also revealed that the enthusiasts of blockchain are thus encouraging early adoption of the technology for their businesses to remain competitive in the market.

Figure 5-1: Author's own (2022)



5.3 Recommendations

Based on the findings of this study on the factors influencing the adoption of blockchain technology in South Africa, certain recommendations emerged that may provide useful insight into organisations, lawmakers and enthusiasts of blockchain technology in South Africa. As demonstrated by the findings of this study, spectrums of success factors and obstacles to the adoption efforts of blockchain technology by organisations were derived. These success factors and obstacles form the basis of the recommendation for this study. The recommendations are, as usual, categorised into three cores namely, organisational, technological and environmental factors.

To enhance the adoption of blockchain technology, companies must provide an organisational structure that allows for improvements and provides flexibility. It needs to be flexible enough to allow people to shift between business and IT units. The IT unit develops blockchain prototypes and links the prototypes to the existing IT

infrastructure in the organisation. The adoption of blockchain relies on people knowledgeable about blockchain and able to work in the business functions or IT units to design use cases and develop prototypes. The right people must be identified and enabled to support the adoption. The type of resources required to enhance the adoption of both infrastructure and IT skills must be available. As shown in the framework below (-/+), the absence of the mentioned requirement will prevent firms from adopting blockchain technology.

Similar to the organisational context, external support in the form of government incentives is required to promote the adoption of blockchain technology. Government regulations regarding policies and legal frameworks concerning *blockchain* with regards to the protection of privacy and security should be provided to promote the adoption of blockchain technology by firms in South Africa.

Similar to environmental factors, technological considerations, such as perceived benefits, perceived compatibility, technology availability and IT security that are being considered for the adoption of new technology, are similar to the environmental factors. Perceived benefits or the relative advantage to be derived by firms should be captivating enough in motivating the adoption decision-making of an organisation's management. The perceived compatibility of the new technology to the architecture of the existing IT infrastructures, IT skills and data usage should be enhanced through redesigning or re-engineering of the processes and procedures.

5.4 Suggestion for future study and research gaps

This study was carried out on a limited number of organisations in South Africa. Future researchers may have to consider employing a large number of organisations spread across the major cities in South Africa. Future research may be considered to establish the degree of influence of the derived variables or factors that emanated from this study on the adoption of blockchain technology.

5.5 Conclusion

This foregoing chapter has provided the key findings and recommendations within the context of the research objectives of the study as a way of providing a conclusion to

the study. Various success factors and obstacles were identified as key findings emanating from the study. These factors were grouped into three major categories of organisational, technological and environmental identifiers. It was revealed in the study that the imperativeness of the conductive structure of the organisations, management support and resources' availability, as precursors for the adoption of blockchain technology, was highlighted. On the other hand, the absence of these factors invariably constitutes obstacles to the adoption of blockchain technology. Similar to the organisational factor, the specific factors in the environment ,which also tend to influence the adoption of blockchain, were identified. The key findings relating to the technological factors were identified, which, amongst other things, include benefits, compatibility, complexity, security and technology availability. To this end, recommendations have been made as to the salient factors to be considered in making an informed decision as to whether or not to adopt blockchain technology.

REFERENCES

Abeyratne, S.A. and Monfared, R.P., 2016. Blockchain ready manufacturing supply chain using distributed ledger. *International Journal of Research in Engineering and Technology*, *5*(9), pp.1-10.

Afande, F.O., Ratemo, B.M. and Nyaribo, F.N., 2015. Adoption of supply chain management practices: Review of determining factors. *Innovative Systems Design and Engineering*, *6*(5), pp.72-77.

Ageron, B., Bentahar, O. and Gunasekaran, A., 2020, July. Digital supply chain: challenges and future directions. In *Supply Chain Forum: An International Journal,* 21(3), pp. 133-138. Taylor & Francis.

Ahram, T., Sargolzaei, A., Sargolzaei, S., Daniels, J. and Amaba, B., 2017, June. Blockchain technology innovations. In *2017 IEEE Technology & Engineering Management Conference (TEMSCON)* (pp. 137-141). IEEE.

Akinradewo, O. I., Aigbavboa, C. O., Edwards, D. J., & Oke, A. E. (2022). A principal component analysis of barriers to the implementation of blockchain technology in the South African built environment. Journal of Engineering, Design and Technology, 20(4), 914-934.

Alicke, K., Rachor, J. and Seyfert, A., 2016. *Supply Chain 4.0 – the next-generation digital supply chain.* Mckinsey & Company. https://www.mckinsey.com/business-functions/operations/our-insights/supply-chain-40--the-next-generation-digital-supply-chain

Anders G., 2015. WhatsApp's growth exceeds Christianity's first 19 centuries. Forbes. http://www. forbes.com/sites/georgeanders/2015/01/08/whatsapps-growth-exceeds-christianitys-first-19- centuries/#1d93431b7771. Accessed 12 Nov 2021.

Babbie, E. and Mouton, J., 2001. *The Practice of Social Research*. South Africa Oxford University Press, Cape Town.

Baker, J. and Steiner, J., 2015. Blockchain: *The solution for transparency in product supply chains*. Provenance: London, UK.

Banerjee, A., 2019. Blockchain with IOT: Applications and use cases for a new paradigm of supply chain driving efficiency and cost. In *Advances in Computers*, *115,* 259-292. Elsevier.

Barber, S., Boyen, X., Shi, E., & Uzun, E. (2012). Bitter to better—how to make bitcoin a better currency. In Financial Cryptography and Data Security: 16th International Conference, FC 2012, Kralendijk, Bonaire, Februray 27-March

2, 2012, Revised Selected Papers 16 (pp. 399-414). Springer Berlin Heidelberg.

Basu, R. and Wright, J. N., 2010. *Total supply chain management*. Routledge.

Behnke, K. and Janssen, M. F. W. H. A., 2020. Boundary conditions for traceability in food supply chains using blockchain technology. *International Journal of Information Management*, *52*, 101969.

Berman, S. J. and Bell, R., 2011. Digital transformation: Creating new business models where digital meets physical. *IBM Institute for Business Value*, *4*.

Bienhaus, F. and Haddud, A., 2018. Procurement 4.0: factors influencing the digitisation of procurement and supply chains. *Business Process Management Journal 24(2), 465-484*.

Bryman, A., 2012. *Social Research Methods*. 4th edition. New York: Oxford University Press.

Buterin, V. (2014). A next-generation smart contract and decentralized application platform. white paper, 3(37), 2-1.

CapGemini, I., 2016. *"GTNexus." The Current and Future State of Digital Supply Chain Transformation*. GT Nexus 1– 12.

Carter, C. and Koh, L., 2018. Blockchain disruption in transport: are you decentralised yet? Available online: https://trid.trb.org/ view/1527923. Accessed 1 June 2022

Casado-Vara, R., Prieto, J., De la Prieta, F. and Corchado, J. M., 2018. How blockchain improves the supply chain: Case study alimentary supply chain. *Procedia Computer Science*, *134,* 393-398.

Chang, S. E., Chen, Y. C. and Lu, M. F., 2019. Supply chain re-engineering using blockchain technology: A case of smart contract-based tracking process. *Technological Forecasting and Social Change*, *144,* 1-11.

Chienwattanasook, K. and Jermsittiparsert, K., 2018. Supply chain integration, supply chain risk practices and supply chain performance: a contingent view. *Opcion*, *34*(86), pp. 2160-2177.

Childhouse, P. and Towill, D. R., 2003. Simplified material flow holds the key to supply chain integration. *Omega, 31*(1), pp. 17-27.

Choi, D., Chung, C. Y. and Lee, K. Y., 2018. Sustainable Diffusion of Inter-Organizational Technology in Supply Chains: An Approach to Heterogeneous Levels of Risk Aversion. *Sustainability*, *10*(6), pp. 2108.

Choi, D., Chung, C. Y., Seyha, T. and Young, J., 2020. Factors affecting organizations' resistance to the adoption of blockchain technology in supply networks. *Sustainability*, *12*(21), p. 8882.

Christidis, K. and Devetsikiotis, M., 2016. Blockchains and smart contracts for the internet of things. *Ieee Access*, *4*, 2292-2303.

Clohessy, T., Acton, T. and Rogers, N., 2018. Business transformation through blockchain. *Business Transformation through Blockchain,(January 2019)*.

Cole, R., Stevenson, M. & Aitken, J., 2019. Blockchain technology: implications for operations and supply chain management. *Supply Chain Management: An International Journal, 24*(4), pp. 469–483

Creswell, J. W., 2009. *Research Design Qualitative, Quantitative and Mixed Methods Approach*. (3rd ed). London: SAGE Publication.

Creswell, J. W. 2003. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 2nd ed. Thousand Oaks, CA: Sage.

Crosby, M., Pattanayak, P., Verma, S. and Kalyanaraman, V., 2016. Blockchain technology: Beyond bitcoin. *Applied Innovation*, *2*(6-10), p. 71.

Darvazeh, S. S., Vanani, I. R. and Musolu, F. M., 2020. Big data analytics and its applications in supply chain management. In *New Trends in the Use of Artificial Intelligence for the Industry 4*, p. 175).

De Vos, A. S. ed., 2002. *Research at grass roots: For the social sciences and human services professions*. van Schaik.

Deloitte. 2017. *Blockchain: Enigma. Paradox. Opportunity*. London: Deloitte LLP.

Deshpande, A., Stewart, K., Lepetit, L. and Gunashekar, S., 2017. Distributed Ledger Technologies/Blockchain: Challenges, opportunities and the prospects for

standards. *Overview report The British Standards Institution (BSI)*, *40*, p.40.

Dickson, B., 2016. How blockchain can change the music industry. TechCrunch, viewed 10 October 2019, available at: https://techcrunch.com/2016/10/08/how-blockchain-can-change-the-musicindustry [Accessed 02 April. 2022

Dornyei, Z., 2007. *Research methods in applied linguistics*. New York: Oxford University Press

Dujak, D.,.and Sajter, D., 2019. *SMART Supply Network.* Springer; Berlin/Heidelberg, Germany. Blockchain applications in supply chain; pp. 21–46.

Ebert, C. and Duarte, C.H.C., 2018. Digital transformation. *IEEE Softw.*, *35*(4), pp.16-21.

Ernst & Young. 2016. Digital Supply Chain: It is all about data, *Report,* 1–15

Fawcett, S. E., Wallin, C., Allred, C. and Magnan, G., 2009. Supply Chain Information Sharing: Benchmarking a Proven Path. *Benchmarking: An International Journal, 16*(2), pp. 222-246.

Francisco, K., & Swanson, D., 2018. The supply chain has no clothes: Technology adoption of blockchain for supply chain transparency. *Logistics*, *2*(1), 2.

Goldratt, E.M. and Cox, J., 2016. *The goal: a process of ongoing improvement*. London. Routledge.

Gordon, W. J. and Catalini, C., 2018. Blockchain technology for healthcare: facilitating the transition to patient-driven interoperability. *Computational and Structural Biotechnology Journal*, *16*, pp. 224-230.

Goyat, R., Kumar, G., Rai, M. K. and Saha, R., 2019. Implications of blockchain technology in supply chain management. *Journal of System and Management Sciences*, *9*(3), pp. 92-103.

Green Jr, K. W., Zelbst, P. J., Meacham, J.and Bhadauria, V. S., 2012. Green supply chain management practices: impact on performance. Supply Chain Management: *An International Journal, 17*(3), pp. 290-305. https://doi.org/10.1108/13598541211227126

Giritli, H., Oney-Yazici, E., Topcu-Oraz, G. and Acar, E., 2006. Organizational culture. *A comparative analysis from the Turkish construction industry CCIM2006 Sustainable Development through Culture and Innovation*, pp.26-29.

Hackius, N.and Petersen, M., 2017. Blockchain in logistics and supply chain: trick or treat? In *Digitalization in Supply Chain Management and Logistics: Smart and Digital Solutions for an Industry 4.0 Environment. Proceedings of the Hamburg International Conference of Logistics (HICL), 23*, pp. 3-18. Berlin: epubli GmbH.

Helo, P. and Hao, Y., 2019. Blockchains in operations and supply chains: A model and reference implementation. *Computers & Industrial Engineering*, *136*, pp. 242-251.

Herbert, L., 2017. *Digital transformation: Build your organization's future for the innovation age*. Bloomsbury Publishing.

Holotiuk, F. and Moormann, J., 2019. Dimensions, Success Factors and Obstacles of the Adoption of Blockchain Technology. In *Australasian Conference on Information Systems, pp. 162–172. https://acis2019. io/pdfs/ACIS2019_PaperFIN_040. pdf*.

Jabbar, S., Lloyd, H., Hammoudeh, M., Adebisi, B. and Raza, U., 2020. Blockchain-enabled supply chain: analysis, challenges, and future directions. *Multimedia Systems*, pp.1-20.

Kahlke, R., Sherbino, J. and Monteiro, S., 2022. 1-2 The Nature of Evidence: Inductive and Deductive Reasoning. *Health Professions Education Research Primer*.

Kakavand, H., Kost De Sevres, N.and Chilton, B., 2017. The blockchain revolution: An analysis of regulation and technology related to distributed ledger technologies. *Available at SSRN 2849251*.

Kalaitzi, D., Jesus, V. and Campelos, I., 2019. Determinants of blockchain adoption and perceived benefits in food supply chains. *RN Conference*. University of Northampton

Kamarulzaman, M. S., Hassan, N. H., Bakar, N. A. A., Maarop, N., Samy, G. A. N. and Aziz, N., 2021. Factors Influencing Blockchain Adoption in Government Organization: A Proposed Framework. In *2021 International Conference on Computer & Information Sciences (ICCOINS)*, pp. 366-371. IEEE.

Kaplan, B. and Maxwell, J. A., 2001. Qualitative Research Methods for Evaluating Computer Information Systems. *Journal of Medical Informatics, 63*(3), pp. 39-56.

Kaplan, B. and Maxwell, J. A., 2005. Qualitative research methods for evaluating computer information systems. In: P. Black & C. Cowell, eds. *Evaluating the organizational impact of healthcare information systems*. New York: Springer, pp. 30-55.

Karafiloski, E. and Mishev, A., 2017, July. Blockchain solutions for big data challenges: A literature review. In *IEEE EUROCON 2017-17th International Conference on Smart Technologies* (pp. 763-768). IEEE.

Kim, H. M. and Laskowski, M., 2018. Toward an ontology-driven blockchain design for supply-chain provenance. *Intelligent Systems in Accounting, Finance and Management*, *25*(1), pp. 18-27.

Kim, J. S. and Shin, N., 2019. The impact of blockchain technology application on supply chain partnership and performance. *Sustainability*, *11*(21), p. 6181.

Collomb, A. and Sok, K., 2016. Blockchain/distributed ledger technology (DLT): What impact on the financial sector? *Digiworld Economic Journal*, 103.

Kowalkiewicz, M., Safrudin, N. and Schulze, B., 2016. The business consequences of a digitally transformed economy. In: Oswald G, Kleinemeier M (eds) *Shaping the digital enterprise: trends and use cases in digital innovation and transformation*. Springer, Heidelberg

Kshetri, N., 2017. Will blockchain emerge as a tool to break the poverty chain in the global south? *Third World Quarterly, 38*(8), 1710-1732

Kshetri, N., 2018. Blockchain's roles in meeting key supply chain management objectives. *International Journal of Information Management*, *39*, pp. 80-89.

Kühn, O., Jacob, A. and Schüller, M., 2019. Blockchain adoption at German logistics service providers. In *Artificial Intelligence and Digital Transformation in Supply Chain Management: Innovative Approaches for Supply Chains. Proceedings of the Hamburg International Conference of Logistics (HICL), 27*, pp. 387-411. Berlin: epubli GmbH.

Kuteyi, D., & Winkler, H. (2022). Logistics challenges in sub-saharan Africa and opportunities for digitalization. Sustainability, 14(4), 2399.

Laaper, S., Fitzgerald, J., Quasney, E., Yeh, W., Basir et al., 2017. Using blockchain to drive supply chain innovation," Digital Supply Chain Management, Logistics. and Procurement. Hamburg. *International Conference on Logistics., 1,* December, p. 2013.

LaBombard, M., McArthur, S., Sankur, A. and Shah, K., 2019. The human side of digital supply chains. Master's thesis. University of Twente. Enschede.

Lakhani, K. R.and Iansiti, M., 2017. The truth about blockchain. *Harvard Business Review*, *95*(1), pp. 119-127.

Leedy, P. D. and Ormrod, J. E., 2005. *Practical research* (Vol. 108). Saddle River, NJ, USA: Pearson Custom.

Lesueur-Cazé, M., Bironeau, L., Lux, G., & Morvan, T. (2020, May). Reflections on Using the Blockchain for Logistics and Supply Chain Management. In 13th International Conference of Research in Logistics and Supply Chain Management, Le Havre, France.

Liao, D. Y., & Wang, X. (2018, November). Applications of blockchain technology to logistics management in integrated casinos and entertainment. In Informatics (Vol. 5, No. 4, p. 44). MDPI.

Lichtman, M., 2006. *Qualitative Research in Education: A User's Guide*. London: SAGE Publication

Lotfi, Z., Sahran, S., Mukhtar, M. and Zadeh, A. T., 2013. The relationships between supply chain integration and product quality. *Procedia Technology*, *11*, pp. 471-478.

Maboe, R. R., 2018. *An Overview of Blockchain Technology in the South African Financial Industry* (Doctoral dissertation, University of the Witwatersrand, Faculty of Commerce, Law and Management).

Mackey, A. and Gass, S., 2005. *Second language research: Methodology and design.* New Jersey: Lawrence Erlbaum Associates, Inc

Malyavkina, L.I., Savina, A.G. and Parshutina, I.G., 2019, May. Blockchain technology as the basis for digital transformation of the supply chain management system: benefits and implementation challenges. In *1st International Scientific Conference Modern Management Trends and the Digital Economy: from Regional Development to Global Economic Growth"(MTDE 2019)* (pp. 10-15). Atlantis Press.

Matthews, R. and Ross, E., 2010. *Research methods: A practical guide for the social sciences*. Pearson Education Ltd.

Mendling, J.; Weber, I.; van der Aalst, W.; Brocke, J.V.; Cabanillas, C.; Daniel, F. and Dustdar, S. 2017. Blockchains for business process management-challenges and opportunities. ACM Transactions on Management Information Systems (TMIS), vol. 9, no. 1, pp. 4, 2018

Mihardjo, L., Sasmoko, S., Alamsjah, F. and Elidjen, E., 2019. The influence of digital customer experience and electronic word of mouth on brand image and supply chain sustainable performance. *Uncertain Supply Chain Management*, *7*(4), pp. 691-702.

Miles, M. B. and Huberman, A. M., 1994. *Qualitative data analysis: An expanded sourcebook*. Sage Publications.

Moberg, C. R., Cutler, B. D., Gross, A. and Speh, T. W., 2002. Identify antecedents exchange within supply chains. *International Journal of Physical Distribution and Logistics management, 32*(9), pp. 755-770.

Mogogole, K. E. and Jokonya, O., 2018. A conceptual framework for implementing IT change management in public sectors. *Procedia Computer Science*, *138*, pp. 835-842.

Mougayar, W., 2016 *The business blockchain: promise, practice, and application of the next Internet technology*. John Wiley & Sons.

Morse, J. M. and Niehaus, L., 2009. *Mixed Methods Design: Principles and Procedures*. Walnut Creek, CA: Left Coast Press

Morrow, S. L. (2005). Quality and trustworthiness in qualitative research in counseling psychology. Journal of counseling psychology, 52(2), 250.

Mouton, J., 2002. *Understanding Social Research*. Pretoria: Schaik Publishers.

Muijs, D., 2004. *Doing Qualitative Research in Education with SPSS*. London: SAGE Publication.

Muijs, D., 2004. Doing Quantitative Research in Education with SPSS. London: Sage Publications Ltd.

Neuman, W. L., 2003. *Social Research Methods: Qualitative and Quantitative Approaches* (5th ed.). Boston: Allyn and Bacon

Nowiński, W. and Kozma, M., 2017. How can blockchain technology disrupt the existing business models? *Entrepreneurial Business and Economics Review*, *5*(3), pp. 173-188.

Oates, B. J., 2009. *Researching Information Systems and Computing.* London: Sage.

O'Marah, K., 2017. Blockchain for supply chain: Enormous potential down the road. Forbes, March 9, 2017, https://www. forbes. com/sites/kevinomarah/2017/03/09/blockchain-for-supply-chain-enormouspotential-down-the-road.

Öberg, C., 2019. The role of business networks for innovation. *Journal of Innovation & Knowledge*, *4*(2), pp. 124-128.

Oswald, G. and Kleinemeier, M., 2017. *Shaping the digital enterprise*. Cham: Springer International Publishing.

Pawczuk, L., Massey, R. and Schatsky, D., 2018. *Breaking blockchain open Deloitte's 2018 global blockchain survey*. Deloitte Consulting: Denver, CO, USA.

Peng, G. C.; Nunes, M. and Annansingh, F. 2011. Investigating Information Systems with Mixed-Methods Research. In *Proceedings of the IADIS International Workshop on Information Systems Research Trends, Approaches and Methodologies.* Rome, Italy

Phadnis, S., 2017. Internet of things and supply chains: A framework for identifying opportunities for improvement and its application. Retrieved from DSpace@MIT: https://dspace.mit.edu/handle/1721.1/109375

Prewett, K. W., Prescott, G. L., & Phillips, K., 2020. Blockchain adoption is inevitable—Barriers and risks remain. *Journal of Corporate Accounting & Finance*, *31*(2), pp. 21-28.

Queiroz, M. M. and Wamba, S. F., 2019. Blockchain adoption challenges in supply chain: An empirical investigation of the main drivers in India and the USA. *International Journal of Information Management*, *46*, pp.70-82.

Ray, P. P., Dash, D., Salah, K. and Kumar, N., 2020. Blockchain for IoT-based healthcare: background, consensus, platforms, and use cases. *IEEE Systems Journal*, *15*(1), pp. 85-94.

Rogers, E. M., 2010. *Diffusion of innovations*. Simon and Schuster.

Sadraoui, T. .and Mchirgui, N., 2014. Supply chain management optimization within information system development. *International Journal of Econometrics and Financial Management*, *2*(2), pp. 59-71.

Sajjad, A., Eweje, G. and Tappin, D., 2015. Sustainable supply chain management: motivators and barriers. *Business Strategy and the Environment*, *24*(7), pp. 643-655.

Saldana, J., 2011. *Fundamentals of qualitative research*. New York, Oxford university press.

SAP 2015 SAP white paper: value creation in a digital economy—adapt or die in a digital world where the consumer is in charge. SAP SE. http://www.ciosummits.com/Digital_Business_ Whitepaper_FINAL_external_09_08_15.pdf. Accessed 11 Nov 2021.

Singh, R. and Jayraman, V., 2013. Supply chain integration and information technology. *International Journal of Economics Business and Management Studies*, *2*(2), pp. 62-74.

Shuttleworth, M., 2019. Face Validity. *Explorable.* https://explorable.com/face-validity

Sulkowski, A .J., 2019. Blockchain, business supply chains, sustainability, and law: The future of governance, legal frameworks, and lawyers. *Delaware Journal of Corporate Law, 43*(2), pp. 303-345

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

Takita, A. M. V. and Leite, J. C., 2018. Inbound logistics: a case study. *Business Management Dynamics*, *7*(12), p.14.

Tabrizi, B., Lam, E., Girard, K., and Irvin, V., 2019. Digital transformation is not about technology. *Harvard Business Review*, *13*(March), pp. 1-6.

Tapscott, D., & Tapscott, A., 2016. *Blockchain revolution: how the technology behind bitcoin is changing money, business, and the world*. Penguin.

Thilakarathna, R. H., Dharmawardana, M. N. and Rupasinghe, T., 2015, December. The Supply Chain Operations Reference (SCOR) model: A Systematic Review of Literature from the Apparel Industry. In *12th International Conference on Business Management (ICBM)*.

Tornatzky, L. G., Fleischer, M., & Chakrabarti, A. K., 1990. *Processes of technological innovation*. Lexington books.

Uddin, M.A., Stranieri, A., Gondal, I. and Balasubramanian, V., 2021. A survey on the adoption of blockchain in iot: Challenges and solutions. *Blockchain: Research and Applications*, p.100006.

Ulin, P. R., Robinson, E. T. and Tolley E. E., 2004. *Qualitative Methods in Public Health: A Field Guide for Applied Research.* Sanfransisco: Jossey-Bass

Utakaeva, I. K., 2019. Directions and features of application of the blockchain technology. In *Journal of Physics: Conference Series*, *1353*(1), p. 012103. IOP Publishing.

Vial, G., 2021. Understanding digital transformation: A review and a research agenda. *Managing Digital Transformation*, 13-66.

Viriyasitavat, W. & Hoonsopon, D., 2019. Blockchain characteristics and consensus in modern business processes. *Journal of Industrial Information Integration*, *13*, pp. 32-39.

Viscusi, W. K., Harrington Jr, J. E., & Sappington, D. E., 2018. *Economics of regulation and antitrust*. MIT press.

Wang, H., Chen, K., & Xu, D., 2016. A maturity model for blockchain adoption. *Financial Innovation*, *2*(1), pp. 1-5.

Waltz, T. J.; Powell, B. J.; Chinman, M. J.; Smith, J. L.; Matthieu, M. M.; Proctor, E. K.; Damschroder, L. J. and Kirchner J. E., 2014. Expert Recommendations for Implementing Change: *Protocol for a Mixed Methods Study. Implementation Science, 9*(39), pp. 1-12

Westerman, G., Bonnet, D., and McAfee, A. 2014. The nine elements of digital transformation. 7, from https://sloanreview.mit.edu/article/the-nine-elements-ofdigital-transformation/

Wright, A., & De Filippi, P., 2015. Decentralized blockchain technology and the rise of lex cryptographia. *Available at SSRN 2580664*.

Yang, J., Liu, H., Xiao, F. and Wang, J., 2021. Identification of Key Drivers for Sustainable Supply-Chain Management of Fresh Food Based on Rough DEMATEL. *International Journal of Information Systems and Supply Chain Management (IJISSCM)*, *14*(2), pp.1-29.

Yin, R. K. 2011. *Qualitative Research from Start to Finish*. New York: The Guilford Press.

Yu, Y., Li, Y., Tian, J. and Liu, J., 2018. Blockchain-based solutions to security and privacy issues in the Internet of Things. *IEEE Wireless Communications*, *25*(6), pp.12-18.

UNIVERSITY of the
WESTERN CAPE

ANNEXURES

ANNEXURE A**: QUESTIONNAIRE**

Faculty of Economics and Management Systems

Department of Information Systems

Factors Affecting the Adoption of Blockchain in South African Logistics Companies

You are invited to participate in a survey to assess the factors affecting the adoption of blockchain in South African logistics companies. This survey is conducted by Selamawit Mathewos Dagne (student number: 3984720), in partial completion of a Master in Information Management degree at the University of the Western Cape.

Please note that the survey is completely anonymous, and the data will only be used for research purposes.

Questionnaire

Section A: Background information

Please check (X) the appropriate box.

Age:	☐ 18-25 years ☐ 26-33 years ☐ 34-41 years ☐ 42-49 years ☐ 50 years and older
Gender:	☐ Male ☐ Female
Position:	☐ Analyst ☐ Executive/senior manager ☐ IT/IS manager ☐ IT/IS specialist ☐ Manager ☐ Other
Duration at the company:	☐ Less than 1 year ☐ 1-2 years ☐ 2-3 years ☐ 3-4 years ☐ 4+ years
Education level:	☐ Certification ☐ Diploma ☐ Undergraduate degree ☐ Postgraduate degree
blockchain experience:	☐ Less than 1 year ☐ 1-2 years ☐ 2-3 years ☐ 3-4 years ☐ 4+ years
Province of the company:	☐ Eastern Cape ☐ Free State ☐ Gauteng ☐ KwaZulu-Natal ☐ Limpopo ☐ Mpumalanga ☐ North West Province ☐ Northern Cape ☐ Western Cape
Number of employees:	☐ Less than 50 ☐ 51-250 ☐ 251-1000 ☐ 1001-5000 ☐ 5001 and more
Has the company adopted Blockchain?	☐ Yes ☐ No

Section B: Factors affecting the adoption of Blockchain

Please check (X) the appropriate box indicating whether you strongly disagree to strongly agree with the statements provided.

Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Technological factors affecting Blockchain adoption					
Perceived benefits					
Blockchain helps improve data security					
Blockchain helps improve data transparency					
Blockchain helps improve data quality					
Perceived complexity					
Blockchain technologies are easy to implement.					
Blockchain technologies are easy to operate.					
Blockchain technologies are easy to maintain.					
Blockchain technologies are easy to learn by my company's employees.					
Perceived compatibility					
Blockchain technology is compatible with my company's current IT infrastructure.					
Blockchain technology is compatible with the data used in my company.					
Blockchain technology is compatible with my company's values.					
Blockchain technology is compatible with my company's existing operations.					
Technology Availability					
My company has access to data from external sources (eg. data from suppliers)					
My company uses automated data capture systems (eg. barcodes, RFID)					
Data stored across various databases in the company are consistent.					
My company does not have a problem with incomplete data.					
All data is captured accurately within my company.					
Security					
My company can easily ensure data privacy when using Blockchain Technology.					
My company can easily comply with Blockchain Technology privacy regulations.					
My company can easily manage risks associated with Blockchain Technology.					
There are existing laws that deal with security and privacy over Blockchain Technology.					
Organisational factors affecting Blockchain adoption					
Organization Size					
My company has more than one location					

Blockchain Technology is rolled out in all departments					
My company has more than 100 employees using Blockchain					
Management Support					
Top management promotes the use of Blockchain Technology.					
Top management supports Blockchain initiatives within my company.					
Top management understands the strategic advantage of Blockchain Technology.					
Top management will provide the resources required to support Blockchain Technology.					
Top management is enthusiastic about Blockchain Technology.					
Top management promotes the use of Blockchain Technology.					
Available Resources					
My company has no difficulty in funding infrastructure to adopt Blockchain Technology.					
My company has no difficulty financing the ongoing maintenance of Blockchain Technology					
My company has no difficulty in finding staff to adopt Blockchain Technology.					
My company has no difficulty obtaining bank loans for Blockchain Technology projects.					
IT Skills					
My company's IT infrastructure supports the adoption of Blockchain Technology.					
My company has no problem hosting and maintaining the IT infrastructure to support Blockchain Technology.					
My company's analytics capabilities support the adoption of Blockchain Technology.					
My company has sufficient skilled resources to support the adoption of Blockchain Technology.					
Environmental factors affecting Blockchain adoption					
External Support					
South African policies and laws support the use of Blockchain Technology in my company.					
The South African government provides incentives for the adoption of Blockchain Technology.					
South African laws on Big Blockchain Technology. protect the privacy and security concerns relating to blockchain.					
My company has no difficulty meeting legal expectations concerning Blockchain Technology.					

South African policies and laws support the use of Blockchain Technology in my company.					
Trading Partner Pressure					
My company would use Blockchain Technology based on whether our trading partners are using it.					
Blockchain Technology gives us a strategic advantage over our trading partners.					
My company is under pressure to use Blockchain Technology by our trading partners.					
Blockchain Technology would help us gain customers from our trading partners.					
Blockchain Technology gives our trading partners a significant advantage.					
Competitive pressure					
My company would use Blockchain Technology based on whether our competitors are using it.					
Blockchain Technology gives us a strategic advantage over our competitors.					
My company is under pressure to use Blockchain Technology by our competitors.					
Blockchain Technology would help us gain customers from our competitors.					
Blockchain Technology gives our competitors a significant advantage.					
Government Regulation					
South African policies and laws support the use of Blockchain Technology in my company.					
The South African government provides incentives for the adoption of Blockchain Technology					
South African laws on blockchain protect the privacy and security concerns relating to Blockchain Technology					
My company has no difficulty meeting legal expectations concerning Blockchain Technology					

Thank you for your participation!

ANNEXURE B: ETHICS APPROVAL LETTER

UNIVERSITY *of the* WESTERN CAPE

60 YEARS *of hope, action & knowledge*

11 November 2021

Ms S Dugne
Information Systems
Faculty of Economic and Management Sciences

HSSREC Reference Number:	HS21/8/28
Project Title:	Factors affecting the adoption of blockchain in logistics in South Africa
Approval Period:	**11 November 2021 – 11 November 2024**

I hereby certify that the Humanities and Social Science Research Ethics Committee of the University of the Western Cape approved the methodology, and amendments to the ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report by 30 November each year for the duration of the project.

For permission to conduct research using student and/or staff data or to distribute research surveys/questionnaires please apply via:
https://sites.google.com/uwc.ac.za/permissionresearch/home

The permission letter must then be submitted to HSSREC for record keeping purposes.

The Committee must be informed of any serious adverse events and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Director: Research Development
University of the Western Cape
Private Bag X 17
Bellville 7535
Republic of South Africa
Tel: +27 21 959 6111
Email: research-ethics@uwc.ac.za

HSSREC Registration Number: HSSREC-130416-049

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

ANNEXURE C**: INFORMATION SHEET**

Private Bag X17, Belville, 7535
South Africa
Tel: +27 (0) 21 959 3680
Fax: +27 (0) 21 959 3522
www.uwc.ac.za

Faculty of Economic and Management Sciences
Department of Information Systems

Research Project Information Sheet: Questionnaire

Project Title:	Factors affecting the adoption of blockchain in logistics in the Western Cape.

What is this study about?
My name is Selamawit Mathewos Dagne and I am a student at the University of the Western Cape (South Africa). I am pursuing a Master's qualification in Information Management, and this study that I am conducting is in partial completion of my degree. The study aims to investigate the technological, organisational and environmental factors affecting the adoption of blockchain in logistics in the Western Cape. Blockchain provides a secure way to store and process information across many network participants and guarantees transparency and privacy of transactions. This study is solely for research purposes.

What will I be asked to do if I agree to participate?
If you agree to participate in this study, you will be asked to respond to a number of questions. This should take approximately 30 minutes. You are encouraged to answer all questions, but you are not required to do so.

Would my participation in this study be kept confidential?
You are not required to provide any personal details, such as your name, address or identity number. All other details such as your age, education, etc are therefore anonymous.

What are the risks of this research?
There are no foreseeable risks.

What are the benefits of this research?
The outcomes of this study can be used by organisations in South Africa adopting Blockchain. Getting an understanding of what factors affect the adoption of blockchain, can allow management to take the necessary steps to address those factors.

Do I have to be in this research and may I stop participating at any time?
Your participation in this survey is completely and entirely voluntary. You may choose not to take part at all. If you do volunteer to participate, you may stop at any time, without any negative or undesirable consequences.

What if I have questions?
If you have any questions feel free to contact the study leader or the student researcher:

Contact details of project leader (study supervisor)
Name: Prof. Osden Jokonya

University of the Western Cape, Department of Info0rmation Systems
Telephone: +27 21 959 1610
Email: ojokonya@uwc.ac.za

Contact details of student
Name: Selamawit Mathewos Dagne
Telephone: 061 349 5978
Email: 3984720@myuwc.ac.za

NOTE: *This research project has received ethical approval from the Humanities & Social Sciences Research Ethics Committee of the University of the Western Cape, Tel. 021 959 2988, email: research-ethics@uwc.ac.za*

ANNEXURE D: CONSENT FORM

UNIVERSITY of the WESTERN CAPE

EMS
Where your Future is our Priority

FACULTY OF ECONOMIC AND MANAGEMENT SCIENCES

Department of Information Systems

CONSENT FORM FOR ORGANISATIONS IN SOUTH AFRICA

RESEARCH TITLE: Factors affecting the adoption of blockchain in logistics in the Western Cape.

I have read the information presented in the information letter about a study being conducted by **Selamawit Mathewos Dagne** towards the Master's Programme at the Information Systems Department at the University of the Western Cape.

This study aims to investigate the technological, organisational, and environmental factors affecting the adoption of blockchain in logistics in the Western Cape.

It has been described to me in a language that I understand and I freely and voluntarily agree to participate. My questions about the study have been answered.

I understand that my identity will not be disclosed and was informed that I may withdraw my consent at any time by advising the student researcher.

With full knowledge of all foregoing, I agree to participate in this study.

Participant Name : _____

Participant Signature : _____

Date : _____

Place : _____

Student Researcher : Selamawit Mathewos Dagne

Student Researcher Signature : 

Student Number : 3984720

Mobile Number : +27 613495978
Email : 3984720@myuwc.ac.za
I am accountable to my supervisor : Prof Osden Jokonya
Department : Information systems department
Telephone : +27 21 959 1610
Fax : +27 21 959 3522
Email : ojokonya@uwc.ac.za

This research project has received ethical approval from the Humanities and Social Sciences Research Ethics Committee, Research Development, of the University of the Western Cape,

Tel. 021 959 2988,
Email: research-ethics@uwc.ac.za

ANNEXURE E: LANGUAGE CERTIFICATE

Registered with the South African Translators' Institute (SATI)

Reference number 1000686

SACE REGISTERED

21 December 2022

FACTORS AFFECTING THE ADOPTION OF BLOCKCHAIN IN LOGISTICS IN SOUTH AFRICA

This serves to confirm that I edited substantively the above document including a Reference list. The document was returned to the author with various tracked changes intended to correct errors and to clarify meaning. It was the author's responsibility to attend to these changes.

Yours faithfully

Dr. K. Zano

Ph.D. in English

kufazano@gmail.com/kufazano@yahoo.com

0631434276