Determinants of organisational blockchain usage behaviour within the South African financial services industry

Ashley J. Paul

Student number: 692930

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ABSTRACT

This report presents findings on individual blockchain usage behaviour at the organizational-level in the South African financial services industry.

The study examined the influences of perceived usefulness, motivational factors, design and implementation, and perceived ease of use, on blockchain adoption behaviour.

Empirical results from quantitative analyses following a survey of technical and non-technical managers within the South African Banking and Financial Service Industry (BFSI) (n = 158) revealed key insights. Perceived usefulness, while important, had a negative effect on blockchain usage behaviour, indicating that managers prioritize other organizational drivers over perceived usefulness. Motivational factors were insignificant, requiring further investigation with aligned respondent profiles. Design and implementation emerged as a highly significant factor, emphasizing the need for well-designed systems, user-friendly interfaces, and integration with existing processes. Perceived ease of use was insignificant, potentially due to managers' assumed background knowledge.

The report concluded by highlighting the complexities and challenges of blockchain adoption in the South African financial services industry and recommended comprehensive education and training, well-designed implementations, and assessment of unique adoption factors. The study contributed to the existing literature by focusing on organisational-level blockchain usage behaviour and extending the Technology Acceptance Model (TAM).

Future research must involve the examination of digital maturity, delivery methodologies, and the impact of non-technical skills on blockchain adoption behaviour. Overall, the study provides valuable insights for practitioners and researchers seeking to enhance blockchain adoption in organizational contexts.

KEYWORDS

Blockchain, Adoption Factors, Banking and Financial Services Industry (BFSI), Individual Usage Behaviour at the Organisational Level, South Africa

DECLARATION

I, Ashley James Paul, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in the field of Digital Business at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Name: Ashley James Paul Signature:

Signed at: Johannesburg

On the 19th day of June 2023

DEDICATION

To my beloved son, Joash James Paul.

With joy and humility, I dedicate this blockchain research study to you. Your goodness and moral compass can make a lasting impact. Use your talents to build a more equitable society with technology. Blockchain's potential is vast – will reshape systems, empower individuals, and foster inclusivity. May your compassion guide you, uplifting the marginalized and amplifying silenced voices. May this dedication remind you of my unwavering love and belief in your boundless potential. May you find fulfilment in using your God-given gifts to create a kinder, fairer, and more compassionate world.

ACKNOWLEDGEMENTS

First and foremost, I humbly acknowledge the Lord Jesus Christ for His unwavering strength and guidance, enabling me to complete this research study on blockchain.

I extend my heartfelt gratitude to my supervisor, Dr. Maradona Gatara, whose exceptional support, unwavering belief, and invaluable guidance have been instrumental in shaping the outcome of this study.

I also want to express my appreciation to my supervisor, Professor Mjumo Mzyece, for his insightful feedback and valuable contributions, which have enriched the quality of this research.

Lastly, I am grateful to my family for their unwavering support and encouragement throughout this journey.

Philippians 4:13: "I can do all this through Him who gives me strength."

TABLE OF CONTENTS

LIST OF ACRONYMS

ATTI	Attitude
AVE	Average Variance Extracted
AW	Awareness
BFSI	Banking and Financial Service Industry
BI	Behavioural Intention
BR	Business Model and Regulation
CC	Customs Clearance
CR	Construct Reliability
CS	Cost Savings
CSE	Computer Self Efficacy
DAPPS	Decentralised Applications
DI	Design and Implementation
DISC	Discomfort
DLT	Distributed Ledger Technology

DOI	Diffusion of Innovation Theory
DP	Digitalizing and ease paperwork
DV	Dependent Variable
EEXP	Effort Expectancy
ERP	Enterprise Resource Planning
FCON	Facilitating Conditions
HTMT	Heterotrait-Monotrait Ratio of Correlations
INN	Innovativeness
INSC	Insecurity
ISS	Information System Success
IT	Information Technology
ITF	Individual Technology Fit
IV	Independent Variable
JR	Job Relevance
KYC	Know your customer

M	Mean
Mdn	Median
NE	Network Externality
OPT	Optimism
OQ	Output Quality
PC	Perceived behavioural control
PCON	Privacy Concern
Penj	Perceived Enjoyment
PEOU	Perceived Ease of Use
PEU	Perceived Ease of Use
PEx	Process Excellence
PEXP	Perceived Expectancy
POC	Proof of Concept
PR	Perceived Risk
PS	Perceived Safety

PT	Perceived Trust
PU	Perceived Usefulness
QOS	Quality of System
RD	Results demonstrability
RR	Risk and Regulatory
SARB	South African Reserve Bank
SI	Social Influence
SN	Subjective Norms
SP	Standardisation and platform
SRMR	Standardised Root Square Residual
TAM	Technology Adoption Model
TAMO	Technology Adoption Model Organisational
TAMO-1 (Blockchain)	Technology Adoption Model Organisational - Blockchain
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Actions

TT	Tracking and tracing
TTF	Task Technology Fit
UDMM	Unified Digital Maturity Model
UI	User Interface
UK	United Kingdom
UTUAT	Unified Theory of Acceptance and Use of Technology
UX	User Experience
WQ	Web quality

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1. INTRODUCTION

1.1 Purpose of the Study

The past decade has seen a slow adoption of blockchain technology. However, current research shows that it has reached an inflection point which will see its rapid implementation across industries. In this study, blockchain usage behaviour is investigated by identifying and examining the effects of its individual adoption in the organisation.

1.2 Context of the Study

Since the introduction of the Bitcoin cryptocurrency electronic cash system in 2009, its underlying technology blockchain, has become a topic of much discussion and debate (Nakamoto, 2008). Blockchain is essentially a distributed ledger that uses a peer-to-peer network of computers to store data cryptographically. This results in all nodes in the network being updated using cryptography to ensure immutability against tampering of records (Almekhlafi & Al-Shaibany, 2021).

There have been many studies, research papers, and articles within academic circles and industry consulting houses that predict the significant disruption of most industries driven by blockchain technology (Almekhlafi & Al-Shaibany, 2021; Budman, 2020; Iansiti & Lakhani, 2017). However, its adoption has been slow over the past decade (Sanka et al., 2021). Many executives have been dabbling with experimentation with limited large-scale deployments. Towards the end of 2019, it has been observed that the hype surrounding Bitcoin has subsided, as more executives are ranking blockchain technology within their top five priorities in solving large-scale business challenges (Budman, 2020).

The Banking and Financial Service Industry (BFSI) is touted as one sector that will face tremendous disruptions (Alt et al., 2018). This stands to reason since the initial application of blockchain was based on cashless electronic payments (Nakamoto, 2008). Given the attributes of blockchain such as security, immutability, consensus, and faster settlement, it questions the need for intermediaries such as banking institutions, as trust is built into the system (Iansiti & Lakhani, 2017). Furthermore, the application of blockchain in “smart contracts” also sets up opportunities for auto-payments and self-executing contracts, which will significantly impact many business processes (Iansiti & Lakhani, 2017).

Although interest in blockchain has started to move from experimentation to more purposeful projects and implementation, some significant barriers, and risks impact blockchain adoption. These include the ability to scale, system integration, lack of standardisation, the complexity associated with blockchain applications, regulatory uncertainty, and lack of knowledge and skills (Prewett et al., 2020). Additional barriers that have been identified include architectural and design risk, end-point and oracle risk (a general IT risk), data security and confidentiality, storage, smart contract risk, compliance, vendor risk, contractual risk, and private key management (Prewett et al., 2020). Blockchain adoption also referred to as blockchain usage behaviour measure the extent to which individuals or organisations are influenced to utilise the technology (Sanka et al., 2021)..

In the South African context, the South African Reserve Bank (SARB) initiated project Khokha in 2018 as a Proof of Concept (POC) to stimulate collaboration between the settlement banks, and by introducing a tokenised South African Rand as a mechanism with which to facilitate wholesale settlements (Bank, 2018). The project was deemed successful and laid the foundation for future research and experimentation. It further highlighted the need for a closer investigation of technological practicalities such as integration into various legacy systems, the economic impacts thereof, and implications of legal and regulatory factors (Bank, 2018).

1.3 Research problem

Since the end of 2019, research indicated that organisations were moving from experimentation to a more strategic priority by applying blockchain technology solutions to large-scale business processes (Budman, 2020). There has been a slow adoption of blockchain technology over the past decade, which has been characterised by the topic being widely researched and subjected to a large amount of experimentation (Woodside et al., 2017).

The current body of research in blockchain usage behaviour highlights that the Technology Adoption Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTUAT) are the most popular models utilised within blockchain adoption research (Almekhlafi & Al-Shaibany, 2021).

Blockchain very much denotes an underlying technological infrastructure that is not directly experienced by individual users (Almekhlafi & Al-Shaibany, 2021; Kawasmi et al., 2020). Individual users are typically unaware of the technology's underlying characteristics and interact with it through a User Interface (UI) that enables the User Experience (UX) through an application. This poses a problem in the research, since most research applies technology acceptance models based on theories that underpin individual-level adoption, whereas blockchain adoption should be examined at the organisational-level (Kawasmi et al., 2020). The decision to adopt the technology does not necessarily occur at the individual end-user level but rather lies with decision makers at the organisational-level. The current state of research lacks a technology adoption model that specifically considers individual user adoption from the organizational-level perspective. Existing technology adoption models primarily focus on individual-level adoption user environments, which may not adequately capture the complexities of blockchain adoption in the organizational context (Kawasmi et al., 2020). Consequently, there is a need to develop and apply individual user technology adoption models at the organizational-level to address this emergent research gap and provide a more comprehensive understanding of blockchain adoption in the financial services industry in South Africa.

As described throughout blockchain literature, the technology is characterised as a system of distributed databases that is connected by an encrypted cryptographic enabled chain, and this highlights the technology as an underlying technological infrastructure (Almekhlafi & Al-Shaibany, 2021; Kawasmi et al., 2020; Sanka et al., 2021; Wang et al., 2020).

Although there have been various theoretical extensions of the TAM, it does not necessarily incorporate the potential broader organisational-level adoption factors that impact blockchain usage behaviour. Organisational blockchain usage behaviour can be associated with the organisation's digital maturity. Digital maturity is defined as the organisations ability to embrace profound technological change whilst achieving desired strategic and operational outcomes (Armstrong & Lee, 2021). As highlighted, the problem with the current body of research is that the assessment of individual usage behaviour becomes less relevant since blockchain is adopted at the organisation-level.

In the context of the South African financial services industry, the relevance of this problem becomes evident. The industry faces unique challenges and dynamics that require tailored approaches to technology adoption. By developing individual user technology adoption models at the organizational-level, we can specifically address the industry's needs and overcome the limitations of existing models.

The specific problem that individual user technology adoption models at the organizational-level will address in the South African financial services industry is the lack of a comprehensive framework that considers the holistic aspects of digital maturity and its impact on successful technology adoption. Digital maturity, defined as an organization's ability to embrace profound technological change while achieving desired strategic and operational outcomes, plays a crucial role in the successful implementation of technologies like blockchain (Armstrong & Lee, 2021). By incorporating dimensions and factors from the Unified Model for Digital Maturity, we aim to provide a more robust and contextually relevant model for organisational-level blockchain adoption.

In their study of SAP ERP adoption, Mohapatra et al. (2015) adapted the Technology Adoption Model (TAM) to Technology Adoption Model Organisation (TAMO) to better cater to organisational technology adoption (Mohapatra et al., 2015). The TAM model was developed to predict technology adoption and usage at the individual-level and states that perceived usefulness and perceived ease of use are determinants of individual technology adoption (Davis, 1989). Mohapatra et al., argued the TAM should not apply to organisational technology adoption, since there are additional factors such as design and implementation, and motivational factors that determine organisational technology adoption (Mohapatra et al., 2015). They extended the TAM to the TAMO. The TAMO still falls short in measuring organisations' digital maturity which ultimately determines success in adopting technologies such as blockchain. In their research, Armstrong et al. (2021) analysed global advisory firms, popular businesses, and academic literature, and proposed the unified model for digital maturity which comprises two dimensions with six factors each (Armstrong & Lee, 2021). The opportunity within the current body of blockchain adoption research is to move towards a more holistic blockchain organisational adoption model focusing on organisational-level blockchain individual usage behaviour. This is achieved by furthering the current technology user specific adoption factors to include organisational-level adoption factors incorporated from the unified model for digital maturity (Armstrong & Lee, 2021). The research gap that prior studies have not adequately addressed is the integration of individual user adoption factors at the organizational-level and the assessment of digital maturity within the context of blockchain adoption. While there have been theoretical extensions of technology adoption models, they do not fully encompass the broader individual user factors that are essential for understanding and promoting successful blockchain usage behaviour at the organisational-level. Therefore, the focus of this study is on individual blockchain usage behaviour at the organisational-level. By bridging this research gap, we can offer valuable insights and recommendations for the South African financial services industry to enhance their adoption strategies and effectively leverage the benefits of blockchain technology.

1.4 Study Objectives

The overall study objective is to investigate the adoption factors influencing individual blockchain usage behaviour at the organizational-level, examining their effects, and exploring the relationships between these factors to provide a comprehensive understanding of how they collectively influence individual blockchain usage behaviour in an organisational context. The following two (2) study objectives are, therefore, specified:

1. Identify the adoption factors that influence individual usage behaviour at the organisational-level.
2. Examine the effects of these adoption factors on individual blockchain usage behaviour at the organisational-level.

These objectives were specified to answer the following formulated research questions:

1. What are the adoption factors that influence individual usage behaviour at the organisational-level?
2. What are the effects of these adoption factors on individual blockchain usage behaviour at the organisational-level?

1.5 Significance of the Study

Implementation of blockchain takes on average 25 months from Proof of Concept (POC) to implementation, with many being discontinued due to a lack of understanding of the technology and regulatory concerns (Rauchs et al., 2019). The significance of this study lies in its contribution to the body of knowledge in blockchain implementation. By investigating usage behaviour at the organizational level, this research aims to provide a comprehensive understanding of the significant factors that impact blockchain adoption, thus informing managers in their proactive planning from technical, risk, digital transformation, and change management perspectives. This would ensure holistic, proactive planning, and faster execution of projects aligned to business strategic objectives.

This study is also relevant to practice and policy directions, particularly in the Banking and Financial Services Industry (BFSI). As this sector faces disruptive changes, the innovative implementation of blockchain technologies can reshape business processes(Alt et al., 2018). By exploring the potential benefits of blockchain, such as leveraging crowdfunding, peer-to-peer lending, and digital Know Your Customer Initiatives (KYC) to address the unbanked population, this research contributes to practical implications for financial institutions."

With the recognition that blockchain implementation may lead to job losses through optimization, digitalization, and automation, understanding its impact in the South African context becomes crucial. This study sheds light on the concerns within the BFSI sector, which is one of the largest employers in a country grappling with high unemployment rates. Thus, the findings of this research have policy implications for employment strategies and workforce planning.

1.6 Scope and Delimitations of Study

This research paper will be limited to:

1. Organisations that fall under the financial services sector in the context of South Africa.
2. Managers across front office, back office, and support services, in these institutions.
3. The existing and pending implementations of blockchain technology to understand individual usage behaviour at the organisational-level.

1.7 Definitions of Terms

a) Blockchain – A "chained" set of blocks through a cryptographic signature that stores digitally recorded data. Through cryptographic consensus, it becomes a tamper-proof digital ledger (Consensys, 2021)

b) Cryptocurrency – Electronic currency, independent of Central Banks, that uses Mathematics and Cryptography to regulate the creation of units (Consensys, 2021).

c) Decentralisation – The transfer of authority from intermediaries to the network (Consensys, 2021).

d) Distributed Ledger – Database spread across multiple sites. Data can be permission-based to control viewing (Consensys, 2021).

e) Immutability – A key attribute of blockchain that provides the basis for its commercial application. Once records have been written into the chain, they cannot be altered (Consensys, 2021).

f) Smart Contracts – The terms of a contract are written into computer programmable language enabling self-execution once terms are met (Consensys, 2021).

g) Tokens – Are unique, transferable, and secure assets built on an existing blockchain (Consensys, 2021).

1.8 Assumptions

Since being introduced in 2009 through the application of Bitcoin cryptocurrency (Nakamoto, 2008), blockchain has been topical, especially in the BFSI, a sector that is set to be disrupted the most (Alt et al., 2018). In banking and financial services, managers would have had some level of exposure, either in the form of awareness to direct experimentation and implementation and would therefore have a reference context. Considering the slow pace of adoption, it would be beneficial to connect current skills with attitudes towards implementing the technology.

As indicated by the global Deloitte Survey of 2020 (Budman, 2020), blockchain has taken its place within the top five strategic priorities on executive dashboards (Budman, 2020). A thorough understanding of organisational blockchain usage factors will inform key programs from a digital transformation perspective, that will have the desired impact on blockchain adoption. This also forms a basis for quality use-case selection, business model innovation, and new value streams (Armstrong & Lee, 2021).

1.9 Chapter Outline

1. Chapter 1 – Introduction

This chapter constitutes an introduction to blockchain technology and the context of the South African financial services industry. The purpose, context, research objective, significance, delimitations, and assumptions of the study, are also described.

2. Chapter 2 – Literature Review

This chapter constitutes a review of the existing literature on blockchain adoption, and the application of technology acceptance theory. The blockchain technology's evolution to the current state and its advancements, are reviewed.

3. Chapter 3 – Research Methodology

This chapter constitutes a detailed description of the research approach, data collection, analysis method, validity, reliability, and limitations of the study.

4. Chapter 4 – Analysis and Presentation of Results

This chapter presents the results of the analysis undertaken on the responses from the research questionnaire.

5. Chapter 5 Discussion of Results

This chapter presents a discussion of the results of previous chapters in relation to chapter two (literature review of blockchain adoption research).

6. Conclusions and Recommendations

This chapter presents recommendations to academics and practitioners, embarking on or undertaking their blockchain journeys.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

In this literature review, the features that make blockchain a disruptive technology are considered. The evolution of blockchain and key application of the technology is highlighted. Key findings on the current state of blockchain are discussed and factors and measurement indicators of blockchain usage behaviour are extracted. These were contrasted in relation to organisational technology adoption factors for a more appropriate model of technology adoption as the current literature is dominated by individual technology adoption models. Various technology acceptance theories and their extensions applied to blockchain technologies are discussed. These extensions are challenged as they are based on individual-level adoption. However, through the literature review process, it is evidenced that blockchain adoption occurs at the organisational-level.

2.2 Definition of Topic

Organisational blockchain usage behaviour is adapted from the TAM and will be used to described usage behaviour or intention to use. Factors are determinants that drive organisational blockchain usage behaviour.

2.3 An Overview of Blockchain Technology

Blockchain, also referred to as Distributed Ledger Technology (DLT), is essentially a group of peer-to-peer blocks of data (nodes) connected via a chain and updated or protected through a consensus-based process (Sanka et al., 2021). Blockchain is tamper-proof as each block contains an encrypted code (hash) of the previous block, and if a record is changed it becomes detectable to the rest of the network (Wang et al., 2020). This attribute enables decentralised trust built into the blockchain technology, and eliminates the need for a centralised intermediary to govern the chain (Sanka et al., 2021). A blockchain structure is depicted in Figure 1.

Figure 1 - Blockchain Structure (Sanka et al., 2021, p. 181) – Chapter 2

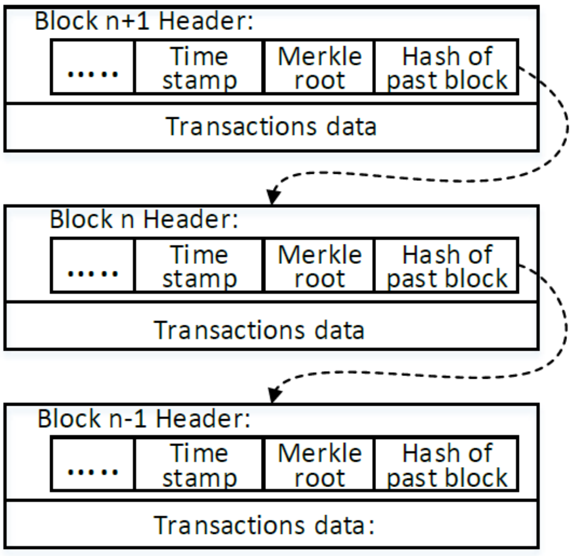


Figure 1 serves as an example, depending on the type of blockchain network, of the information and structure stored in a chain. In this example, the structure has a Merkle root, which is a list of transactions stored in the blockchain (Sanka et al., 2021).

2.3.1 *The Important Features of Blockchain*

Blockchain is described as an exponential technology that will profoundly impact how we operate as a society, as was the advent of the Internet in the 1990s (Beck & Müller-Bloch, 2017). The technology contains fundamental attributes that present opportunities to reimagine the way in which processes work across most industries.

a) Distributed Nature

Data loss and record tampering are prevented due to all blocks on the network simultaneously containing a replication of the information. Any block that is added will download a copy of the blockchain from other blocks (Iansiti & Lakhani, 2017).

b) Data Integrity and Security

Due to the cryptography where a mechanism adds a timestamp string that is generated by random hash function is applied to each block. Each one carries the previous block's hash, any changes to a block alters the hash, rendering it unmatched with the next block. Any attempt to tamper with it will require every block to be modified down from the genesis block for all computers. Practically, an adversary will be impeded, hence the data is secured from tampering (Wang et al., 2020).

c) Anonymity

Personal details of participants are hidden due to scrambled hex digits. However, there are still concerns about privacy since this can be deciphered using statistical software. In private blockchain, identity could be exposed to prevent fraud. Privacy can be enhanced through further encryption (Sanka et al., 2021).

d) Transparency and traceability

Audit and tracking capabilities are positively enhanced due to all transactions or records being stored on all the nodes. Any changes are therefore tracked, and this assists in the detection of fraudulent transactions (Sanka et al., 2021).

e) Decentralised nature

Although private blockchain and blockchain consortiums may allocate control to a few if not all its member nodes, blockchain effectively eliminates the need for intermediaries and, in so doing, caters to a system with in-built trust where contracting parties can transact confidently as rules are executed within the code of the system (Wang et al., 2020).

f) Cost-Savings

Effective implementation of blockchain will result in huge cost savings since the need to rely on intermediaries will be eliminated. (Van Steenis et al., 2016). As a result, it is observed that blockchain is a top-five strategic priority for most leading executives in the current context (Budman, 2020).

g) Speed

The settlement, especially of international remittances, is much faster as there is no need for intermediaries and latencies to be removed, and no back office function is required (Sanka et al., 2021).

h) Efficiency

Through blockchain, system autonomy is achieved, and there is no reliance on sub-intermediary systems (transitioning systems within a system architecture), thereby increasing efficiency through self-executing capabilities.(Sanka et al., 2021).

i) Interoperability

Blockchain creates better client experiences since organisations can share and synchronise data across traditional silos. This benefits multi-sided business platform strategies across organisations such as banking and insurance (Narayanan & Clark, 2017).

j) Verifiability

The cryptography capability of blockchain ensures that records can be verified. This cannot be achieved in traditional or current databases as it requires digital signatures (Sanka et al., 2021).

k) Right to be forgotten

Blockchain stores information immutably across various locations which can contain personal information such as passwords, medical records, and other information-types. Further, records could contain information of an illegal nature. Under these circumstances, the data will need to be removed by enforcement of a court order. Given that the record is stored in many different locations, there lacks a method to deal with such complexity (Sanka et al., 2021).

2.3.2 *Types and Generations of Blockchain*

Based on the way the network is operated or managed, three types of blockchain exist, namely Private, Public, or Consortium (Almekhlafi & Al-Shaibany, 2021).

a) Private Blockchain

Private blockchain requires permission to join the network. Thus, it is referred to as a Permissioned blockchain. It is characteristic of rules that control which node may transact and view certain transactions. They are typically used in private enterprises and considered undeletable or permanent (Almekhlafi & Al-Shaibany, 2021).

b) *Public Blockchain*

One does not require permission to access this network. Just the correct specialised software is required. They are fully transparent and typically meant to operate cryptocurrency such as Bitcoin, the first public blockchain (Almekhlafi & Al-Shaibany, 2021).

c) *Consortium Blockchain*

Consortium blockchains can be described as a hybrid between private and public blockchains, where selected nodes may be assigned to participate in consensus processes. It is centralised partially with limited public use. They are typically used in networks involving multiple organisations (Almekhlafi & Al-Shaibany, 2021).

The literature highlights four generations of blockchain:

a) *First Generation Blockchain (Blockchain 1.0)*

The first generation of blockchain is represented by cryptocurrency such as Bitcoin and Litecoin, among others (Almekhlafi & Al-Shaibany, 2021).

b) *Second Generation Blockchain (Blockchain 2.0)*

The arrival of Smart Contract, a self-executable software based on stated conditions, marks second generation blockchain technologies, such as Ethereum (Almekhlafi & Al-Shaibany, 2021).

c) *Third Generation Blockchain (Blockchain 3.0)*

Regarded as a general-purpose technology spanning multiple industries and applied to various processes such as contract management, Internet of Things (IoT), supply chain management, healthcare, insurance, and Internet payments (Almekhlafi & Al-Shaibany, 2021).

d) Fourth Generation Blockchain (Blockchain 4.0)

This will integrate Artificial Intelligence (AI) to combine cognitive capability, which will further enhance innovative application and further reduce human dependency (Almekhlafi & Al-Shaibany, 2021).

As the technical advances in blockchain continue to reduce the technological barriers such and scalability, energy consumption and speed as example, these cannot advance blockchain adoption in isolation. A more holistic view of blockchain adoption factors, extending from individual blockchain usage behaviour at the user level, to individual blockchain usage behaviour at the organisational-level is required to drive successful adoption.

2.3.3 *The Applications of Blockchain*

The literature highlights the adoption of blockchain across many industries such as inter alia banking and financial services, government and the public sector, the automotive industry, telecoms, e-commerce and retail, healthcare, the logistics and supply chain sector, real estate, music, media, and gaming (Nuryyev et al., 2020; Rauchs et al., 2019; Sanka et al., 2021; Wang et al., 2020).

Blockchain has been applied to use cases across a variety of sectors or industries as highlighted by Table 1 (Sanka et al., 2021).

Table 1 - Blockchain Application Across Industry - Chapter 2

Area of Application	Discussion
Cryptocurrency	As the first application of blockchain technology, Bitcoin, the most successful cryptocurrencies, has a market capitalisation of $726 billion as of 14 June 2021 (Bitcoin.com, 2021).

	It is estimated that there are between 2.9 million and 5.8 million cryptocurrency wallet users globally (Kakushadze & Serur, 2018). It is estimated that 36% of small businesses accept Bitcoin as payment in the US, whereas 56% purchase Bitcoin for their own use. Bitcoin is accepted by Microsoft, Expedia, Wikipedia, Burger King, KFC, Subway, Norwegian Air, and more (Beigel, 2020).
Smart contract	A Smart contract is essentially a contract that is governed by computer software that becomes self-executing when respective conditions of the contract are fulfilled. It was introduced in 1994, run on blockchain such as Ethereum, Hyperledger, Corda and Namecoin for Decentralised Applications (Dapps), and doesn’t require intermediary governance (Szabo, 1997). There are over 14 million contracts on Ethereum, and Solidity is the most popular language for the design of smart contracts (Pinna et al., 2019).
Stock Exchange	Secondary share markets leveraging blockchain have come into existence and do not have the high costs of intermediaries (Almatarneh, 2020). Developments within the London Stock Exchange and the Australian Security Exchange are all set to integrate blockchain into their systems (Crosby et al., 2016).
Healthcare Management	Four broad categories within healthcare are leveraging blockchain as a solution. These are records management, medical insurance, clinical and biomedical research, and applications connecting various healthcare providers (Mazlan et al., 2020). The challenges of data inconsistency, poor records

	management, duplicate records etc., can be eliminated by leveraging blockchain (Griggs et al., 2018).
Insurance	Blockchain applications in insurance enable faster and seamless claims processes that provides audit trail and transparency, thereby mitigating fraud. Digitisation of assets also further enhances business models and creates client-centric ecosystems (Sanka et al., 2021). The application for certification history of diamonds in companies such as Everledger and use cases across companies such as Etherisc, Insurwave, and MedRec are other examples (Crosby et al., 2016; Raikwar et al., 2018)
Banking and Finance	The first banking transaction of blockchain was carried out between the Commonwealth Bank of Australia and Wells Fargo in 2016. Since the very attributes of blockchain place banks under pressure from an intermediary perspective, banks have been trying to improve their systems leveraging blockchain (Zheng et al., 2018).
Internet of Things (IoT) Industry	The application of Blockchain to the IoT includes IBM ADEPT, where home appliances troubleshoot and upgrade themselves. Further application involves the integration with IoT to monitor inventory on the cold storage supply chain (Zheng et al., 2018).
Blockchain-based DNS services	Blockchain is utilised to administer domain name services as a mechanism to protect against cyber-attacks and misuse (Ali et al., 2017).

Decentralised Data Storage	Traditional centralised storage of data provides a single point of failure, and by utilisation of blockchain, data storage can be decentralised, thereby mitigating this risk. Storj is a decentralised cloud storage network leveraging blockchain (Storj, 2021).
Intellectual Properties and Document Stamping	Blockchain is used to protect Intellectual Property (IP) where documents are stored on the blockchain once it is digitally signed. Companies such as Stampery, Block, Notary, and Microsoft utilise blockchain for this purpose (Crosby et al., 2016).
Voting	Many developing countries face election-rigging and fraud, which can be eliminated with blockchain. Agora voting, Bitcongress, and Remotengrity, are projects that provide good frameworks for blockchain voting (Foroglou & Tsilidou, 2015).
Digital Identity Management	The management of identity through physical documents such as passports is open to fraud. Many countries such as the United States (US), Japan, Switzerland, India, and Finland are conducting blockchain-enabled identity trials (Sanka et al., 2021).
Cyber Security	In cybersecurity, blockchain is used to store network history, configuration, log files and other network files preventing attacks through its immutable attribute (Bouckaert et al., 2010).
Asset Registry and Tokenisation	Blockchain provides secure tokenisation of assets and prevents theft and asset fraud. Sweden, Russia, the

	United Kingdom (UK), and India are conducting trials in this regard (Sanka et al., 2021).
Supply Chain and Trade Management	Supply chain management is enhanced in terms of improved transparency, efficiency, cost, speed through the adoption of blockchain. Maersk founded Tradelens, a blockchain-enabled supply chain company (Sanka et al., 2021).
Energy Trading and Management	Blockchain is currently being used for the trade of electricity and data management across smart grids. Powerledger is an Australian company facilitating transactions between suppliers and consumers of energy (Monrat et al., 2019).
Contract Management	Contract management carries high operational costs and risks. Blockchain enables contract management free of intermediaries. Numerous companies offer contract management as a solution, such as Monax, Corda, Oracle, Konfidio, and Incertis (Sanka et al., 2021).

2.3.4 *Blockchain Evolution – Important Milestones*

The significant breakthroughs experienced in blockchain technology adoption during 2018 and 2019 has termed the current era as the years of enterprise blockchain. Table 2 and Figure 2 highlight key breakthroughs along the blockchain journey (Sanka et al., 2021).

Figure 2 - Breakthroughs on the Blockchain Journey (Sanka et al., 2021, p. 190). – Chapter 2

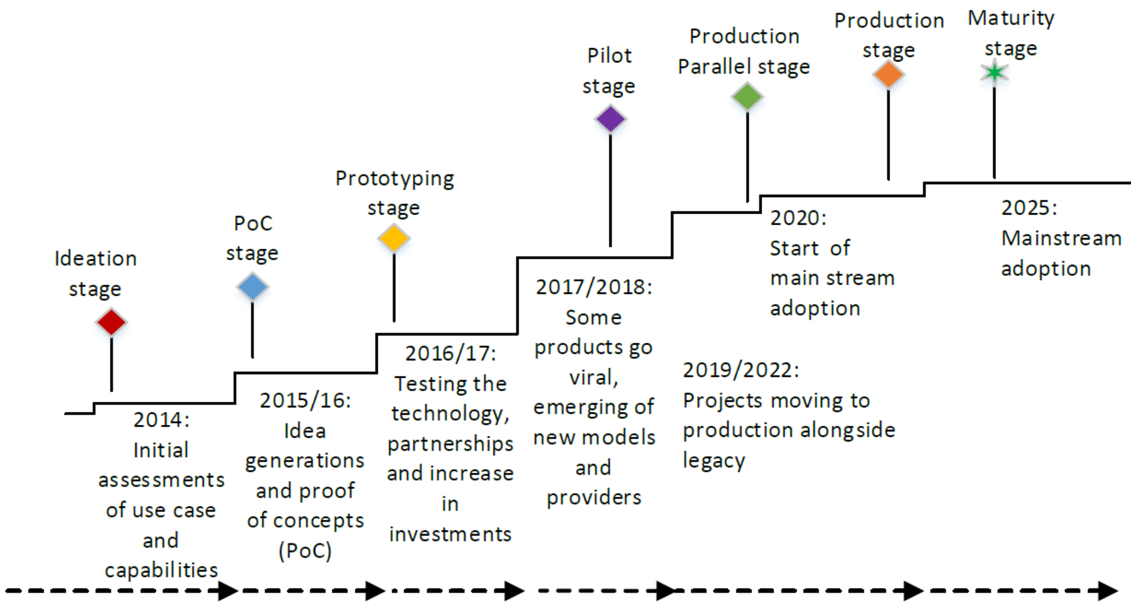


Table 2 - Key Milestones - Blockchain Evolution (Sanka et al., 2021) - Chapter 2

Period	Discussion
2012 - 2014	The primary use of blockchain was for the administration of cryptocurrencies such as Coinbase, Coinsetters, and Peercoin (Sanka et al., 2021).
2014 - 2016	Organisations start to experience the early benefits of blockchain use since the launch of Ethereum. Stock exchanges like Nasdaq implement blockchain, and collaborations give rise to payments with Citi. Autonomous Decentralised Peer-to-Peer Telemetry (ADEPT), unveiled by Samsung and IBM, allows devices to communicate for autonomous upgrades and maintenance (Sanka et al., 2021).
2016 - 2018	A transaction for 88 bales of cotton worth $35,000 became the world's first international blockchain payment between Wells Fargo and Commonwealth Bank of Australia. Microsoft embedded the Application Programming Interface (API) of Stampery, which could be used for the certification of documentation. Since 2016, the R3 consortium (200 plus

	financial institutions) has been using blockchain for trading, issuance, and redeeming fixed-income products. There has been greater acceptance of cryptocurrencies globally (over 100 000 entities) (Sanka et al., 2021).
2018 - 2020	Major adoption in the automotive sector, encompassing companies such as BMW, Ford, Renault, and GM. Mobility Open Blockchain Initiative (MOBI) implements blockchain for data sharing between vehicles. Oracle integrates blockchain into its cloud offerings, including contract management. FedEx is exploring IoT and blockchain integration for tracking purposes. There have also been implementations of innovative use cases on tracking unused cancer medication. LG announced Uplus for international payments, leveraging blockchain. Implementations of blockchain in healthcare and contract management. Australian Security Exchange announces plans to implement blockchain as a clearing and settlement system. Maersk implements blockchain as part of its supply-chain management through Tradelens. Facebook cryptocurrency receives much publicity and widespread adoption of blockchain across multiple industries (Sanka et al., 2021).

2.3.5 *Review of Surveys*

The literature indicates that blockchain has been significantly researched both in academic and industry circles. Sanka et al. (2021) analysed 12 surveys with the following studies highlighted:

a) Cambridge University: 67 deployed use cases in 25 countries, 60 blockchain vendors, 56 blockchain network operators, and 45 public sectors from 25, 22, and 33 countries, respectively (Sanka et al., 2021).
b) Stanford University: 110 Organisations in 6 sectors (Agriculture, Finance, Environment, Governance, Digital Identity and Health) (Sanka et al., 2021).
c) Deloitte: 1386 top executives in 12 countries and 31 organisations.

d) Price Waterhouse Coopers (PWC) – 600 big business executives in 15 regions (Sanka et al., 2021).
e) IPSOS - Centre for International Governance Innovation (CIGI): Over 10,000 people from 25 countries (Sanka et al., 2021).

The methods of data gathering included inter alia direct survey by invitation, email, social networks, phone interviews, and digital surveys (Sanka et al., 2021). The findings of the research were categorised into 14 dimensions as highlighted in Table 3.

Table 3 - Overall Findings of Review – Chapter 2

Dimensions	Finding
Analysis of Current State of Blockchain adoption	There was a marked increase in blockchain adoption showing a significant increase of about 86% towards the end of 2019 (Budman, 2020).
Survey of Blockchain Platforms in Use	In terms of enterprise blockchain applications, Hyperledger Fabric is the most widely used. However Ethereum is the most popular platform used for both permission and permissionless networks (Galen et al., 2019).
Multi-party Blockchain Vs Blockchain Meme Networks	A multiparty blockchain (Distributed Ledger Technology) works on consensus and shared record keeping. A blockchain meme works on only some components such as cryptography. 77% of 67 surveyed are blockchain memes. 20% are considering

	multiparty DLTs and 3% are full DLT networks (Rauchs et al., 2019).
Analysis of Sectors using Blockchain	The sectors with the most implementations were the Insurance and Financial industries in the public sector (China, 2018; Rauchs et al., 2019).
Analysis of Blockchain Use Cases	Supply chain management had the most amount of enterprise blockchain networks, whilst most use cases deployed were for records storage and verification (China, 2018).
Analysis of the Smart Contract languages in Use	General purpose programming languages such as Java and Solidity are the most popular at 69% (Rauchs et al., 2019).
Enterprise Blockchain Consensus Algorithms Analysis	The most popular used consensus algorithm is The Practical Byzantine Fault Tolerance (PBFT) (Rauchs et al., 2019).
Privacy and Confidentiality Methods Analysis	In terms of enterprise blockchain privacy methods, pseudonymous addresses, and restricted transaction visibility are the most popular (Rauchs et al., 2019).
Key Motivation/Driver of Enterprise Blockchain Networks	72% of the blockchain use cases were implemented or in development target cost reduction (Carson et al., 2018; Rauchs et al., 2019).
Duration of Blockchain Project Completion	The surveys showed that it took about 25 months from POC (Proof of Concept) to full scale deployment of the solution. The major obstacles

	being regulatory and lack of understanding of the technology. (Rauchs et al., 2019). The Deloitte survey highlights that 47% of the respondents expect a return within 1 – 3 years (Budman, 2020).
Criteria for Platform Selection	Choosing the correct platform is critical to success. The most important selection criteria was vendor maturity (Rauchs et al., 2019).
Cause of Blockchain Project Discontinuation	The main causes of stopping projects were high cost and lack of understanding of the technology. Another significant contributing factor was that respondents could not extract benefits (Rauchs et al., 2019).
Overall Satisfaction of Existing Blockchain	The results show that most of the respondents are satisfied with the results of implemented use cases (Sanka et al., 2021).
Survey of Obstacles impeding wider Blockchain Adoption	The main obstacles were regulatory in nature and characterised by a lack of understanding (China, 2018; Rauchs et al., 2019). Other significant obstacles: • Compelling use case, vendor immaturity (China, 2018; Rauchs et al., 2019). • Lack of standardisation (China, 2018; Rauchs et al., 2019) • Shortage of skilled blockchain developers (China, 2018; Rauchs et al., 2019).

	• Reluctance to replace the current systems (China, 2018; Rauchs et al., 2019).

(Sanka et al., 2021) recommend further blockchain research in the areas of scalability, big data analytics, blockchain verification, interoperability, secure consensus protocols, post-quantum cryptosystems, and integration of blockchain with other systems (Sanka et al., 2021).

2.3.6 *Review of Journal Articles*

Published in March 2021, Almekhlafi et al., (2021) reviewed journal articles from 2017 to 2021 from 7 Scopus databases (ScienceDirect, Springer, IEEE, Emerald, Taylor & Francis, MDPI, and Wiley), with a view to determining factors influencing users to adopt blockchain, the adoption models, industries, and methodologies (Almekhlafi & Al-Shaibany, 2021).

In their review, they investigated 21 studies on blockchain adoption and being a new topic, 68% of the articles examined were published in 2020, with 28% in 2019 (Almekhlafi & Al-Shaibany, 2021). Most of the studies were quantitative with only one being mixed-method-based (interview and survey). The countries covered were Brazil, Italy, Pakistan, Spain, Taiwan, India, United Arab Emirates (UAE), Malaysia, and Australia (Almekhlafi & Al-Shaibany, 2021). In the studies, researchers used seven adoption models, the Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), Task-Technology Fit (TTF), Unified Theory of Acceptance and Use of Technology (UTAUT), Information Systems Success Model (ISSM), and Diffusion of Innovation Theory (DOI). The TAM and UTUAT models were the most popular accounting for 71% and 28% of the studies sampled, respectively (Almekhlafi & Al-Shaibany, 2021). It was further noted that the rest combined the TAM and UTUAT Models, and in one study, the DOI was exclusively used (Almekhlafi & Al-Shaibany, 2021). Although blockchain emerged as the technology driving cryptocurrency, the studies focused on service and manufacturing industries, energy, tourism and hospitality, small micro-industries, maritime, logistics, auditing, and health care. Supply chain management received the most attention as an area of focus, accounting for 33% of the studies (Almekhlafi & Al-Shaibany, 2021). Table 4 highlights the results of blockchain adoption research per industry.

Table 4 - Results of Blockchain Adoption Research by Industry – Chapter 2

Industry	Factors	Discussion
Bitcoin	1. Perceived Risk (PR) 2. Perceived Usefulness (PU) 3. Perceived Ease of Use (PEU)	The study utilised the TAM model, involved research through qualitative interview and case study found PEU and PU to be positive (Folkinshteyn & Lennon, 2016).
Supply Chain	1. Discomfort (DISC) 2. Insecurity (INSC) 3. Perceived Usefulness (PU) 4. Perceived Ease of Use (PEOU) 5. Attitude (ATTI) 6. Subjective Norms (SN) 7. Perceived Behavioural Control (PC) 8. Behavioural Intention (BI)	The study in India, utilised the TAM, TRA, and TPB models, researched through quantitative instrument and found that PU, ATTI, and PC, had positive significant impacts on BI. In addition, SN had a weak impact on BI, and DISC was found to be insignificant (Kamble et al., 2019).
Digital Currency	1. Awareness (AW) 2. Perceived Ease of Use (PEOU)	This study in the UAE utilised the TAM, for which research survey data was collected through a quantitative questionnaire. It was

	3. Perceived Usefulness (PU) 4. Social Influence (SI) 5. Perceived Trust (PT)	found that PU, PT, SI, and PEOU had a significant positive impact on intention (Saif Almuraqab, 2020).
Maritime Shipping	1. Customs Clearance (CC) 2. Digitalising and Ease of Paperwork (DP) 3. Tracking and Tracing (TT) 4. Standardisation and Platform (SP) 5. Business Model and Regulation (BR)	The study in Taiwan, used the TAM model and for which research survey data was collected through a questionnaire, found that CC, DP, and SP had a positive significant impact on intention to use (Gil-Cordero et al., 2020).
Blockchain-Based Smart Lockers	1. Individual-Technology Fit (ITF) 2. Task-Technology Fit (TTF) 3. Perceived ease of use (PEOU) 4.Perceived usefulness (PU) 5. Attitude (ATT) 6. Usage Intention (UI) 7. Network Externality (NE) 8. Perceived Safety (PS)	The research based in Taiwan Utilised the TAM and TTF model and followed a quantitative approach, for which research survey data was collected through a questionnaire indicating that PU and PEOU had insignificant impacts. PS and NE were insignificant (Lian et al., 2020).

Corporate Governance	1. Individual-Technology Fit (ITF) 2. Task-Technology Fit (TTF) 3. Perceived Ease of Use (PEOU) 4. Perceived Usefulness (PU) 5. Attitude (ATT) 6. Usage Intention (UI) 7. Network Externality (NE) 8. Perceived Safety (PS)	A quantitative study utilised the TAM and for which research survey data was collected through a questionnaire, indicating that the model fit validated the various constructs as per the theorized model (Singh et al., 2019)
Supply Chain	1. Performance Expectancy (PEXP) 2. Facilitating Conditions (FCON) 3. Effort Expectancy (EEXP) 4. Behavioural Intention (BI) 5. Social Influence (SINF)	In Brazil, a quantitative study, for which research survey data was collected through a questionnaire, utilised the UTUAT. It was found that SINF had a significant positive impact on UTUAT constructs (Wamba & Queiroz, 2019).
Blockchain based research data – Sharing system	1. Perceived Ease of Use (PEOU) 2. Usefulness (PU) 3. Quality of System (QOS) 4. Perceived Enjoyment (PEnj)	This study extended the TAM, in a quantitative study conducted via an online survey, found that PEnj and QOS had stronger impacts on PU. However, PEOU was

	5. Intention to use (ITU)	insignificant for PU (Shrestha & Vassileva, 2019).
Service and manufacturing industry	1. Attitude (ATT) 2. Behaviour Intention (BI) 3. Innovativeness (INN) 4. Optimism (OPT) 5. Perceived Behavioural control (PBC) 6. Perceived Usefulness (PU) 7. Perceived Ease of Use (PEOU) 8. Subjective Norms (SN)	A Pakistan-based study, in which the TAM, TRI, and TPB models were examined and for which research survey data was collected through a questionnaire indicating that PEOU, ATT, PBC, and PU had significant positive impacts on BI (Ullah, 2020).
Energy Management	1. Perceived Ease of Use (PEOU) 2. Perceived Usefulness (PU) 3. Attitude (ATT) 4. Cost Saving (CS) 5. Innovativeness (INN) 6. Behavioural Intention (BI)	A quantitative study conducted via questionnaire utilised the TAM and TRA models indicating that BI was positively impacted by PEOU, ATT, PU, and CS. INN showed a significant positive impact on PEOU (Ullah et al., 2020).
Cryptocurrency	1. Performance Expectancy 2. Web Quality (WQ)	Study based in Spain followed the quantitative approach and utilised extended TAM. It was found that

	3. Trust 4. Electronic Word of Mouth (E-Wom) 5. Perceived Risk (PR) 6. Behavioural Intention (BI)	all factors had significant positive impacts on BI (Gil-Cordero et al., 2020).
Cryptocurrency	1. Attitude (A) 2. Perceived Behavioural Control (PBC) 3. Subjective Norm (SN) 4. Behavioural Intention (BI)	A South African study that followed a quantitative approach through which the TPB was applied. It was found that A and PBC positively impacted intention to adopt. However, SN was found to be insignificant (Mazambani & Mutambara, 2019).
Business in Tourism and hospitality SMEs	1. Strategic Orientation (SO) 2. Social Influence (SI) 3. Innovativeness (INN) 4. Self-Efficacy (SE) 5. Perceived Usefulness (PU) 6. Perceived Ease of Use (PEOU) 7. Behavioural Intention (BI)	This study extended the TAM and followed a quantitative approach through a survey. It was found that SO and Owners characteristics had a significant positive impact on BI. Technology Characteristics, Gender and Age were found to be insignificant (Nuryyev et al., 2020).
Logistics Industry	1. Perceived Ease of Use (PEOU) 2. Perceived Usefulness (PU)	An online study used TAM and the approach was a quantitative study that found PEOU, PU, and ATT

	3. Attitude (ATT) 4. Behavioural Intention (BI) 5. Actual Behaviour (AB)	had a significant, positive impact on BI (Jain et al., 2020).
Accounting and auditing profession	1. Computer Self-Efficacy (CSE) 2. Perception of External Control (PEC) 3. Job Relevance (JR) 4. Output Quality (OQ) 5. Results Demonstrability (RD) 6. Effort Expectancy (EE) 7. Performance Expectancy (PE) 8. Social influence (SI) 9. Intention (INT)	An Italian study that used TAM3 and UTUAT and followed a quantitative approach via questionnaire where it was found that PE, SI, and EE had significant positive impacts on INT (Ferri et al., 2020).
Healthcare services	1. Privacy Concern (PCON) 2. Perceived Utility (PU) 3. Perceived Ease of Use (PEOU) 4. Behavioural Intentions (BI) 5. Trust (T)	An India-based study that utilised the TAM and followed a quantitative approach for which research survey data was collected through a questionnaire and found that PU, PEOU, Trust, and PCON were significant

		predictors of BI (Dhagarra et al., 2020).

(Almekhlafi & Al-Shaibany, 2021)

Almekhlafi et al., (2021) found that perceived ease of use and perceived usefulness are the most important factors influencing user's intention to adopt blockchain as a technology across the 21 studies within the cross-section of industries (Almekhlafi & Al-Shaibany, 2021).

The limitations of their study highlight that only seven databases were used and further recommend future studies on organisational adoption since the studies focussed on individuals. It is also recommended that post-implementation research be conducted with a view to understand the development of adoption (Almekhlafi & Al-Shaibany, 2021).

In 2020, Kawasmi et al., (2020) conducted a study on establishing an adoption model for blockchain use in banking through research incorporating 25 selected articles published between 2015 and 2018 (Kawasmi et al., 2020). The documents comprised white papers, research papers, and reports from Central Banks as well as fintech companies.

Kawasmi et al., (2020) classified three factors for blockchain adoption in banking. First, there are **Supporting Factors** (Enhanced Data Exploration, Regulatory Compliance, Improving the KYC Process, Improved Transactions Speed, Smart Contracts, and Increased Transparency). Second, there are **Hindering Factors** (Scalability, Energy Consumption, Currency Stability, Legislations, and Regulations, and Governance). Third, there are **Circumstantial Factors** (Costs, Security, and Interoperability) and new factors, through literature review (Kawasmi et al., 2020). They then analysed the documents (Figure 3) through a text mining approach involving data preparation, data cleaning, frequency analysis, and categorisation (Kawasmi et al., 2020). The findings of the research in terms of their categorisation, incorporated Adoption Supporting Factors, Adoption Hindering (Barriers), and Adoption Circumstantial Factors, as depicted in Figures 3, 4, and 5, respectively (Kawasmi et al., 2020).

Figure 3 - Adoption Supporting Factors (Kawasmi et al., 2020, p. 134) – Chapter 2

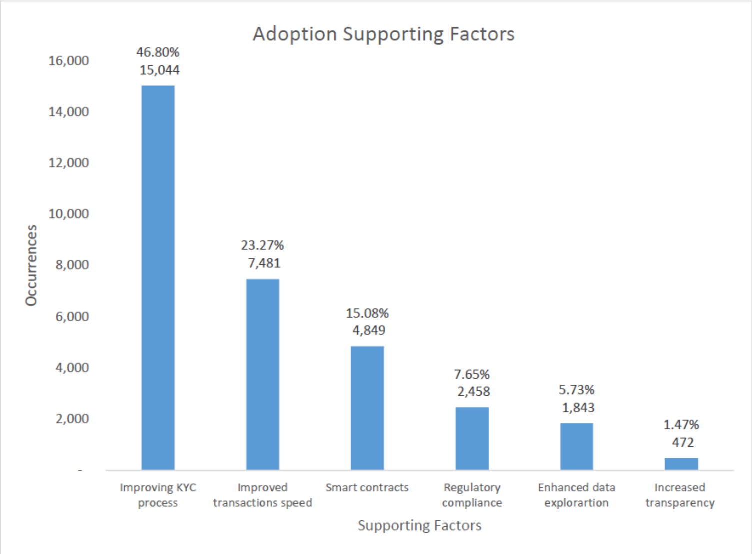
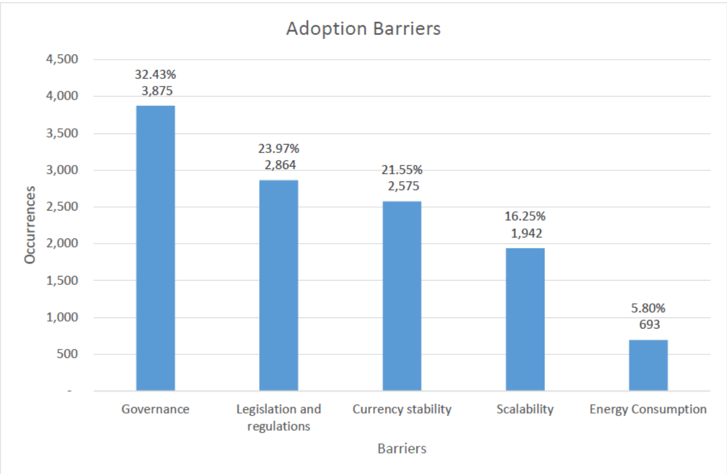


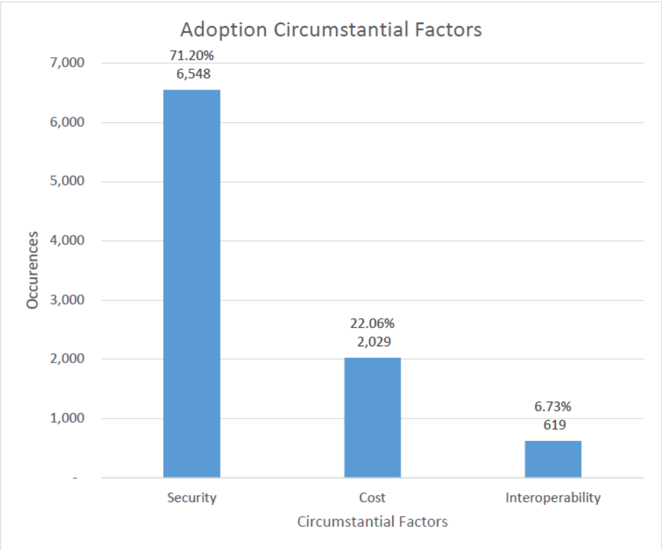
Figure 3 shows that the top three, namely improving KYC, improved transaction speed, and smart contract, account for about 85%, whilst the remaining 15% are allocated between regulatory compliance, enhanced data exploration, and increased transparency (Kawasmi et al., 2020).

Figure 4 - Adoption Barriers (Kawasmi et al., 2020, p. 135) – Chapter 2



In terms of Adoption Barriers, the finding from research conducted by Kawasmi et al., (2020) was that governance accounted for 32% was the highest barrier whilst energy consumption represented 5.8%, the lowest obstacle. Legislation and regulation, currency stability, and scalability, ranged between 16% and 24% (Kawasmi et al., 2020).

Figure 5 - Adoption Circumstantial Factors (Kawasmi et al., 2020, p. 136) – Chapter 2



In terms of Adoption, Circumstantial Factors as Security featured as the most prominent at 71% (Kawasmi et al., 2020). Kawasmi et al., (2020) further identified Competitive Advantage as a new factor as it stood independently (Kawasmi et al., 2020).

The review of the current state of the research indicates that since its introduction through cryptocurrency, blockchain has advanced through experimentation to a mature technology that is currently a top-five strategic priority for most executives globally (Budman, 2020). The past decade has seen slow adoption as research into the technical, regulatory, and business-risk components was undertaken. However, with the evolution towards blockchain 3.0, faster implementation is expected (Almekhlafi & Al-Shaibany, 2021). The review of the blockchain adoption research highlighted forty-nine predictors (indicators) of blockchain usage behaviour at the individual user level, as displayed in Figure 12 below.

2.4 Analytical Framework

In developing the analytical framework of the study, it is important to critically investigate extensions of the TAM to accommodate blockchain usage behaviour.

In the case of Kawasmi et al., (2020), the significant Supporting, Hindering and Circumstantial factors were ranked in importance based on occurrence, and then incorporated into their extension of the TAM. Kawasmi et al., (2020) eliminated the PEOU from the TAM, explaining that blockchain is not a system, but rather exhibits characteristics of an infrastructure and is therefore not utilised at the individual user-level but rather at the organisational-level (Kawasmi et al., 2020). Figures 6 and 7 highlight the ranked factors and their inclusion into their extension of the TAM.

Figure 6 - Ranked Blockchain Factors (Kawasmi et al., 2020, p. 140) – Chapter 2

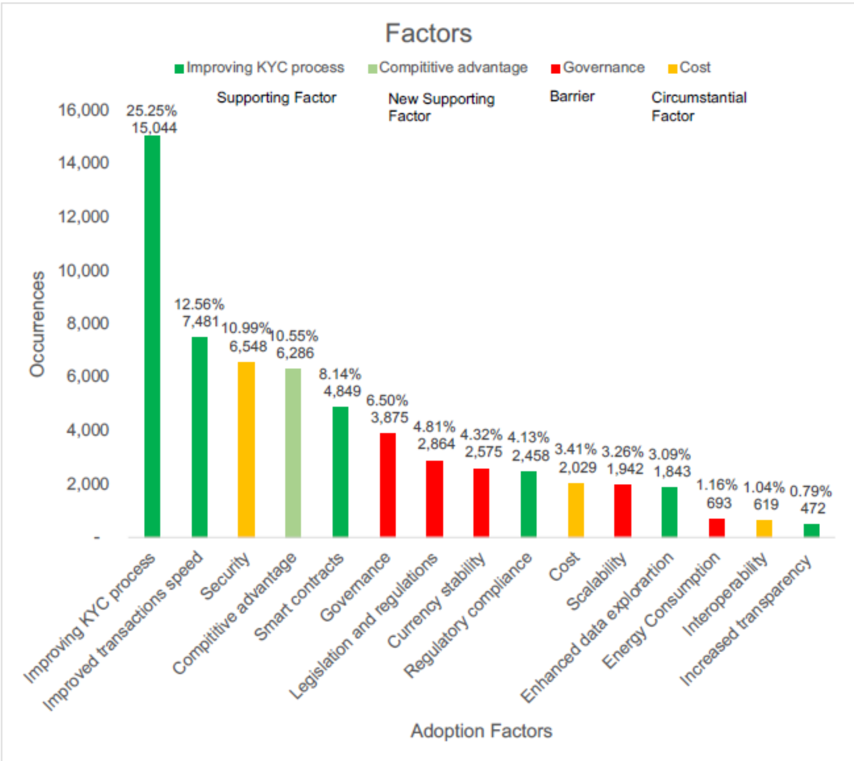
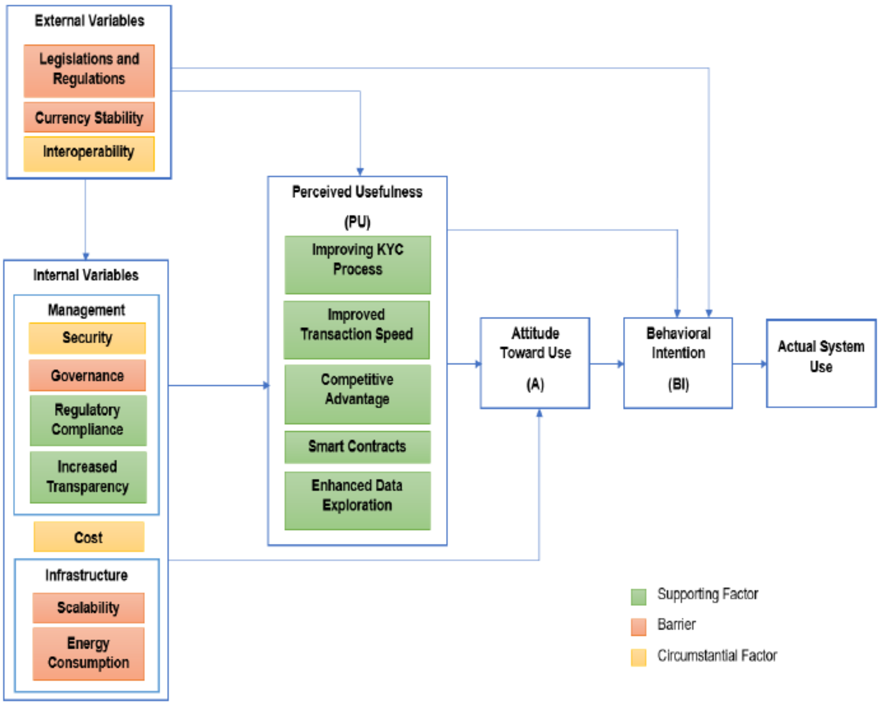


Figure 7 - Adapted Blockchain TAM (Kawasmi et al., 2020, p. 142) – Chapter 2

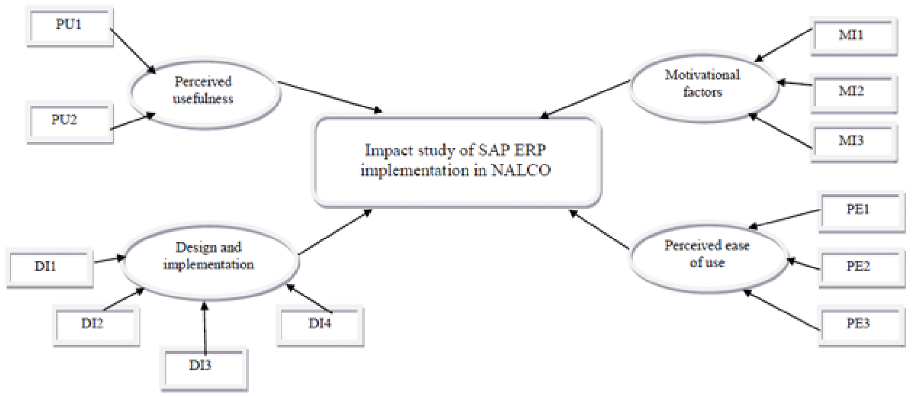


As highlighted by Kawasmi et al., (2020), users do not experience blockchain technology first-hand, but through an Application or user interface (UI) that delivers the user experience (UX). In research conducted by Sanka et al., (2021) and Almekhlafi et al., (2021), the shortcoming, regarding the application of technology adoption models to individuals rather than the organisation, is also highlighted. From a technological perspective it is further evidenced, throughout the blockchain literature, that the technology fits the profile of an underlying technology like that of an infrastructure. Given that in most of the studies conducted, the popular use of TAM and UTUAT surface a gap in the research on blockchain usage behaviour, since these models consider adoption at the individual user level (Almekhlafi & Al-Shaibany, 2021; Kawasmi et al., 2020; Sanka et al., 2021).

The application of technology adoption models that are designed to assess individual adoption, to measure organisational technology adoption, will prove to be problematic. This is because there are significant factors impacting organisation technology adoption that are not included in these models. It therefore becomes necessary to extend individual technology adoption models, to include organisational determinants of blockchain usage behaviour.

Faced with a similar difficulty i.e., the inadequacy of TAM to assess organisational technology adoption, Mohapatra et al., (2015) extended the TAM from individual focus to an organisational focus, that is, TAMO Technology Adoption Model Organisation) (Figure 8), in their research on SAP ERP adoption at the National Aluminium Company Limited (Mohapatra et al., 2015). Their research resulted in extending the TAM by incorporating several constructs as per Figure 8.

Figure 8 - TAMO - Organisational Adaptation (Mohapatra et al., 2015, p. 254) – Chapter 2



Perceived Usefulness (PU)	**Design & Implementation (DI)**
"PU1: Streamlining, standardisation of processes and practices"	*"DI1: Stakeholder management in the decision process"*
"PU2: Benefits of the process"	*"DI2: Effective review process by the senior management"*
	"DI3: Training effectiveness and skills imparted"
	"DI4: Risk management"
Motivational Factors (MI)	**Perceived Ease of Use (PE)**
"MI1: Rewards and recognition"	*"PE1: Complexity of the application"*
"MI2: Willingness to use the new system"	*"PE2: System working as per the expectations"*
"MI3: User satisfaction"	*"PE3: Integration of system"*

(Mohapatra et al., 2015)

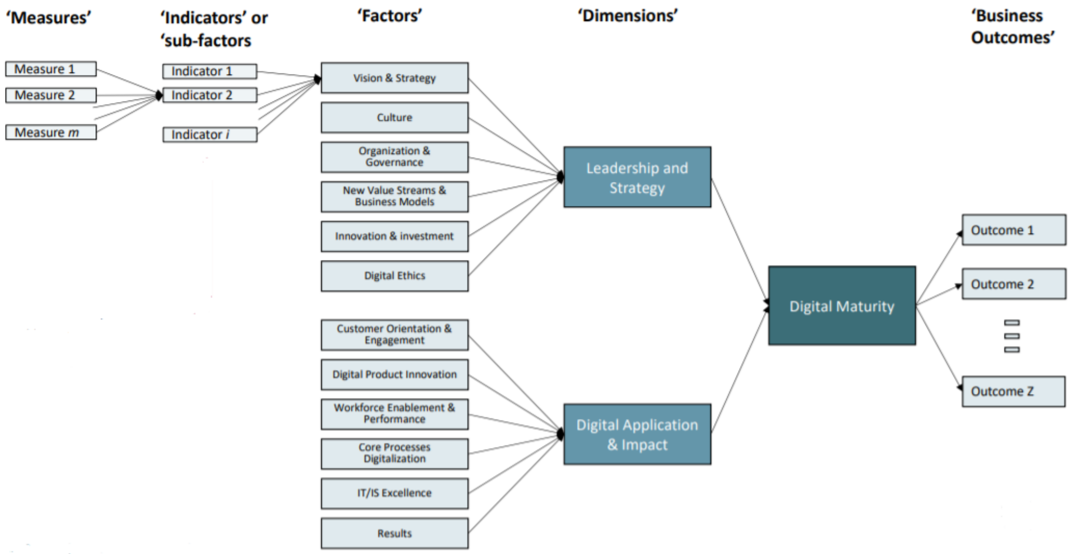
Accordingly, Mohapatra et al., (2015) developed a useful extension of TAMO capable of assessing technology adoption at the organisational-level. However, within the body of blockchain research, it was found that there have been extensions of the TAM, but the direction has been purely focused on the technology and regulatory aspects neglecting organisational blockchain usage behaviour. It is further noted that the research lacks significant factors especially at the organisational-level. This requires further extension of TAM to include organisational technology adoption factors which sit within the research on organisation digital maturity.

Armstrong et al., (2021), through their study of global advisory firms, popular business and academic literature, proposed the unified model for digital maturity which comprises two dimensions with six factors each, as displayed in Figure 9 (Armstrong & Lee, 2021). Armstrong et al., (2021) describe digital transformation as not just about adopting exponential technology, but also about delivering on the purpose of the organisation (Armstrong & Lee, 2021). They further define digital maturity as the "measure of an organisation's ability to achieve desired strategic and operational outcomes in the presence of, and embracing, profound technological change" (Armstrong & Lee, 2021). Since organisational digital transformation (maturity) involves many facets driven by organisation-wide change, it surfaces the interrelationships between the factors that come into play. Collectively, these factors not only influence business results, but also each other. Therefore, they become predictors of the organisation's maturity in adapting and adopting new technology.

In comparing the unified digital maturity model as per Figure 9 (Armstrong & Lee, 2021), to blockchain adoption (TAM and its various extensions) and SAP ERP enterprise adoption (TAMO) (Mohapatra et al., 2015), it becomes clear that by inclusion of factors such as digital product innovation, new value streams and business models, innovation and investments, and digital ethics, it will make for a more holistic technology adoption model capable of measuring organisational blockchain usage behaviour more accurately. These factors have been identified to be lacking in the previous and current adoption models being employed to assess organisational-level blockchain usage behaviour.

It is also noted through the analysis of blockchain adoption literature that the factor highlighted as having the most significant impacts on organisational blockchain usage behaviour is perceived usefulness. The factor that displays the weakest impact on organisational usage behaviour is motivational factors.

Figure 9 - Unified Digital Maturity Model (Armstrong & Lee, 2021, class slide) - Chapter 2



A fundamental realization that blockchain is adopted at the organisational-level and less by individual users, emphasises a need for deeper understanding of factors that drive organisational rather than individual usage behaviours. It is on this basis that a more appropriate analysis framework be constructed and tested, so that it accounts for variations in organisational blockchain usage behaviours.

2.5 Conceptual Framework

Through the process of analysing the blockchain adoption literature, factors influencing individual blockchain usage behaviour at the organisational-level were identified (Figure 10). The theories that underpin the development of the conceptual model for the purpose of the study is based on the TAM, as well as the extension TAMO, and the Unified Digital Maturity Model. The TAMO (Mohapatra et al., 2015) was compared to the Unified Digital Maturity Model (Armstrong & Lee, 2021) and a specific set of factors which then informed the development of the conceptual model to test individual blockchain usage behaviours at the organisational-level. In examining the TAMO (Mohapatra et al., 2015) and the Unified Digital Maturity Model (Armstrong & Lee, 2021) from the existing literature, a number of factors were adopted with which a conceptual model was developed in order to explain individual blockchain usage behaviour at the organisational-level as displayed in Figure 11.

Figure 10 - Conceptual Process – Chapter 2

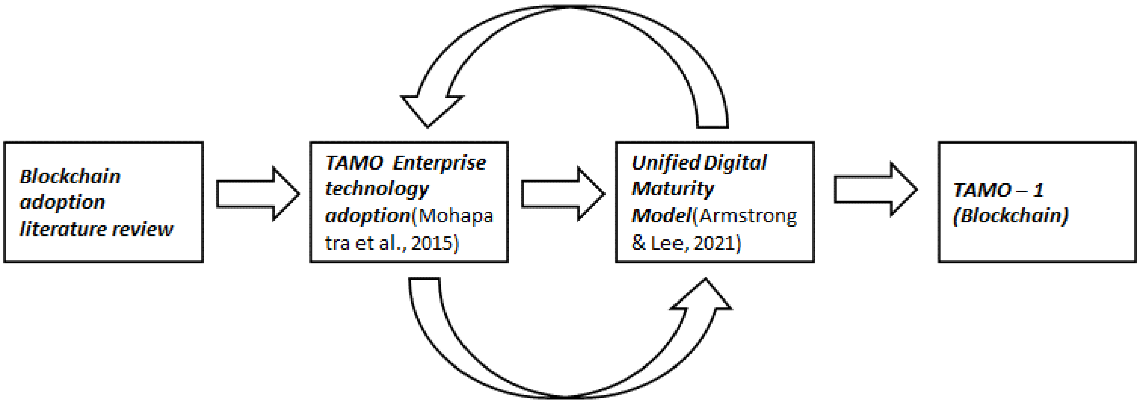


Figure 11 displays the conceptual framework that will be adopted in the present study to conduct research into organisational blockchain via individual usage behaviour.

Incorporating Digital product innovation (PU3), New Value Streams and Business models (PU4), Innovation and Investments (DI5), Digital Ethics (DI6) as factors from unified digital maturity model (Armstrong & Lee, 2021), together with an identified forty-nine underlying dimensions through the literature review, would provide a more holistic account of the factors impacting individual blockchain usage behaviour in an organisation. These dimensions are mapped to the constructs Perceived Usefulness, Motivational Factors, Design and Implementation, and Perceived Ease of Use, respectively.

Figure 11 - Conceptual Model – Chapter 2

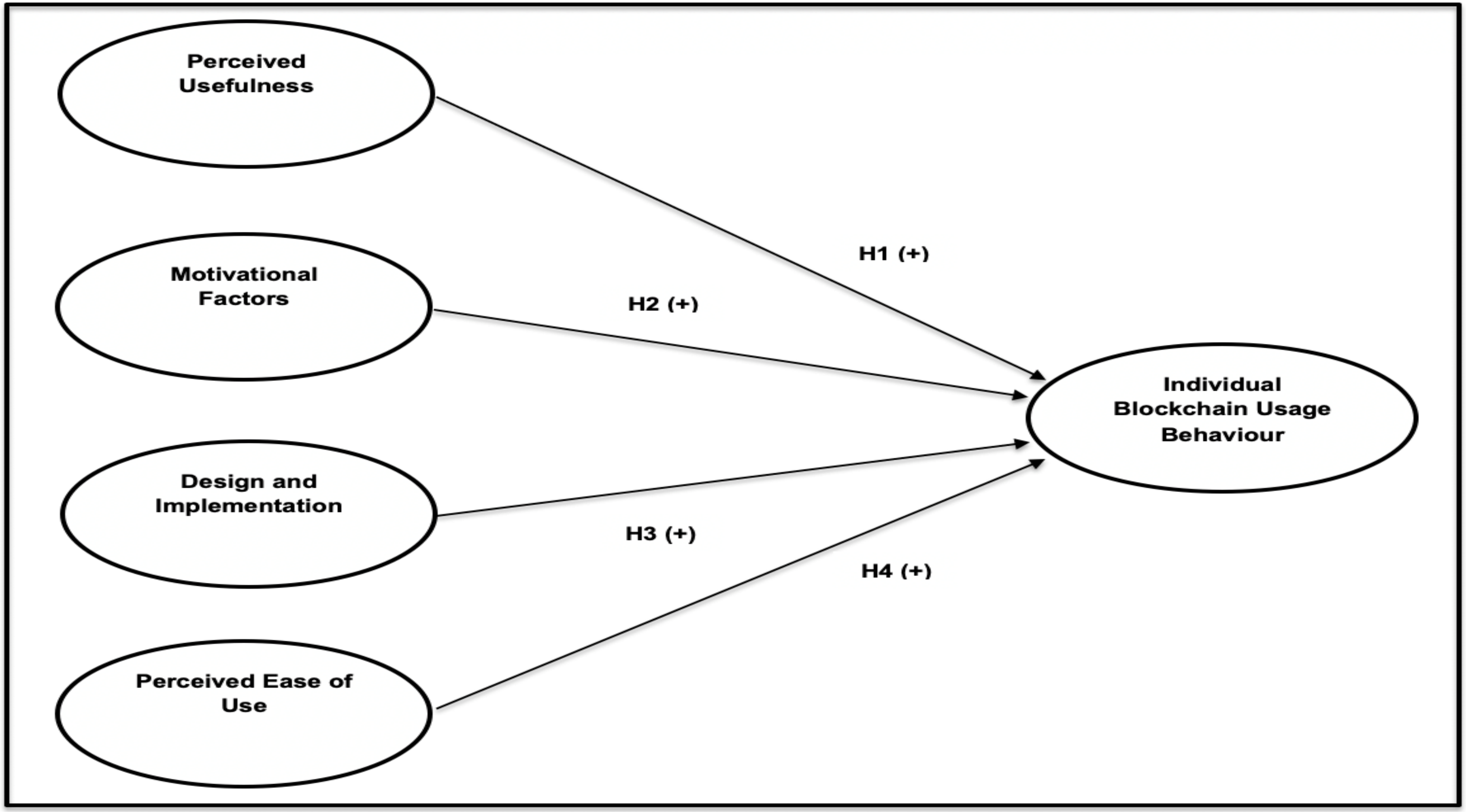


Figure 12 - Analysis of Blockchain Adoption Factors – Chapter 2

	Factor Extraction - Blockchain Specific	TAMO Class	TAMO Sub Class	Uni.Dig. M Class
1	Lack of understanding and skills	DI	DI3	D3
2	Privacy and confidentiality concerns	DI	DI4	
3	Regulatory issue	DI	DI4	
4	Possible security threat	DI	DI4	
5	Fear of competitive information sensitivity	DI	DI4	
6	Regulatory uncertainty	DI	DI4	
7	Concerns for Audit/compliance	DI	DI4	L3
8	Regulatory compliance	DI	DI4	L3
9	Legislations and regulations	DI	DI4	L3
10	Governance	DI	DI4	L3
42	Not our business priority	DI		
43	Funding issues	DI		L5
44	Insufficient funding	DI		L5
45	Concerns for intellectual property	DI		L6
46	Moral hazards reduction	DI		L6
11	No executive buy-in	MI	MI2	L1
12	Users not trusting each other	MI	MI3	D3
13	PEOU	PE	PE	PE
14	Technical issues	PE	PE1	D5
15	Scalability issues	PE	PE1	D5
16	Scalability	PE	PE1	D5
17	Energy Consumption	PE	PE1	D5
18	Currency stability	PE	PE1	
19	Not suitable for business case	PE	PE2	
20	Replacing/adapting existing legacy systems	PE	PE3	D5
21	Consortium formation challenges	PE	PE3	D5
22	Ability to integrate network	PE	PE3	D5
23	Interoperability	PE	PE3	D5
24	PU	PU	PU	PU
25	Efficiency improvement across boundaries	PU	PU1	D4
26	Transparency improvement	PU	PU1	D4
27	Efficiency improvement within boundaries	PU	PU1	D4
28	Improving the KYC process	PU	PU1	D4
29	Improved transactions speed	PU	PU1	D4
30	Smart contracts	PU	PU1	D4
31	Increased transparency	PU	PU1	D4
32	New revenue generation	PU	PU2	L4
33	Cost savings	PU	PU2	D6
34	Competitive advantages	PU	PU2	D6
35	Assets trading	PU	PU2	D6
36	Failed to realise tangible benefits	PU	PU2	D6
37	Uncertain benefit/return	PU	PU2	D6
38	Enhanced data exploration	PU	PU2	L4
39	Costs	PU	PU2	D6
40	Security	PU	PU2	D5
41	Interoperability	PU	PU3	D5
47	Lack of compelling application	PU		D2
48	Blockchain is unproven	PU		D2
49	Market competition	PU		L4

Code	Unified Digital Maturity Model - Armstrong
L	**Leadership & Strategy**
L1	Vision and Strategy
L2	Culture
L3	Organization and Governance
L4	New Value Streams and Business Models
L5	Innovation and Investment
L6	Digital Ethics
D	**Digital Application & Impact**
D1	Customer Orientation and Engagement
D2	Digital Product Innovation
D3	Workforce Enablement and Performance
D4	Core Processes Digitilization
D5	IT/IS Excellence
D6	Results

Code	TAMO - Mohaptara
PE	**Perceived Usefulness (PU)**
PU1	*Streamlining, standardisation of processes and practices*
PU2	*Benefits of the process*
MI	**Motivational Factors (MI)**
MI1	*Rewards and recognition*
MI2	*Willingness to use the new system*
MI3	*User satisfaction*
DI	**Design & Implementation (DI)**
DI1	*Stakeholder management in the decision process*
DI2	*Effective review process by the senior management*
DI3	*Training effectiveness and skills imparted*
DI4	*Risk management*
PE	**Perceived Ease of Use (PE)**
PE1	*Complexity of the application*
PE2	*System working as per the expectations*
PE3	*Integration of system*

Code	TAMO-1 (Blockchain)
PE	**Perceived Usefulness (PU)**
PU1	*Streamlining, standardisation of processes and practices*
PU2	*Benefits of the process*
PU3	*Digital Product Innovation*
PU4	*New Value Streams and Business Models*
MI	**Motivational Factors (MI)**
MI1	*Rewards and recognition*
MI2	*Willingness to use the new system*
MI3	*User satisfaction*
DI	**Design & Implementation (DI)**
DI1	*Stakeholder management in the decision process*
DI2	*Effective review process by the senior management*
DI3	*Training effectiveness and skills imparted*
DI4	*Risk management*
DI5	*Innovation and Investment*
DI6	*Digital Ethics*
PE	**Perceived Ease of Use (PE)**
PE1	*Complexity of the application*
PE2	*System working as per the expectations*
PE3	*Integration of system*

Notes:

(Almekhlafi & Al-Shaibany, 2021; Kawasmi et al., 2020; Sanka et al., 2021) studies highlighted forty nine blockchain specific factors, which the researcher compared to (Mohapatra et al., 2015) TAMO. With a view on organisational usage behaviour, comparisons to (Armstrong & Lee, 2021), Unified digital maturity model was also done. It was found that four additional indicators i.e., "digital product innovation, new value streams and business models, innovation and investments, and digital ethics" should be added to TAMO, thereby strengthening the model's ability to predict organisations blockchain usage behaviour. The resultant model TAMO-1 (blockchain)

The proposed conceptual model shown in Figure 11 displays four constructs (Perceived Usefulness, Motivational Factors, Design and Implementation and Perceived Ease of Use) as highlighted by the TAMO in studying individual technology adoption and user behaviour at the organisational-level (Mohapatra et al., 2015).

2.5.1 *Perceived Usefulness*

The literature highlights that perceived usefulness influences individual blockchain usage behaviour (Almekhlafi & Al-Shaibany, 2021). The more a user perceives a technology to be useful in one's activity the more likely they are to use it. Decision makers act on behalf of the organisation in adopting technology, therefore the extended TAM which was named the TAMO (Mohapatra et al., 2015).

Hypothesis 1 (H1): Perceive Usefulness has a positive influence on individual blockchain usage behaviour at the organisational-level.

2.5.2 *Motivational Factors*

Motivational factors influence individual blockchain usage behaviour at the organisational-level. It is likely blockchain usage behaviour will increase the more motivated decision makers are to use a technology. Motivational factors was found to be a significant factor in the study of organisational technology adoption (Mohapatra et al., 2015). The following hypothesis is therefore proposed:

Hypothesis 2 (H2): Motivational Factors has a positive influence on individual blockchain usage behaviour at the organisational-level.

2.5.3 *Design and Implementation*

Design and implementation influences organisational individual technology usage behaviour (Mohapatra et al., 2015). Implementations that have been poorly designed and deployed have a higher risk of failure (Prewett et al., 2020).

Due to these failures emanating from poorly designed implementation of blockchain technology, it will become less desirable to adopt. The following hypothesis is therefore proposed:

Hypothesis 3 (H3): Design and Implementation has a positive influence on individual blockchain usage behaviour at the organisational-level.

2.5.4 *Perceived Ease of Use*

Perceived ease of use significantly influences individual blockchain usage behaviour at the organisational-level, as indicated extensively throughout the literature (Folkinshteyn & Lennon, 2016; Gil-Cordero et al., 2020; Jain et al., 2020; Kamble et al., 2019; Saif Almuraqab, 2020; Shrestha & Vassileva, 2019; Singh et al., 2019; Ullah, 2020). The easier the technology is perceived to be utilised, the more likely it is that its usage will increase. Across a different a cross-section of industry, perceived ease of use is highlighted as one of the most important factors for individual blockchain adoption (Almekhlafi & Al-Shaibany, 2021). The following hypothesis is therefore proposed:

Hypothesis 4 (H4): Perceived Ease of Use has a positive influence on individual blockchain usage behaviour at the organisational-level.

Overall, the conceptual model of the study comprised of the following hypothesis:

Hypotheses 1 (H1): Perceive Usefulness, has a positive influence on individual blockchain usage behaviour at the organisational-level.

Hypotheses 2 (H2): Motivational Factors has a positive influence on individual blockchain usage behaviour at the organisational-level.

Hypotheses 3 (H3): Design and Implementation has a positive influence on individual blockchain usage behaviour at the organisational-level.

Hypotheses 4 (H4): Perceived Ease of Use has a positive influence on individual blockchain usage behaviour at the organisational-level.

CHAPTER 3. RESEARCH METHODOLOGY

3.1 Introduction

In the previous chapter, the relevant literature was presented, a conceptual model was developed, and hypothesis were formulated. A set of determinants were predicted to influence individual blockchain usage behaviour in organisations.

In this chapter, the data collection methods and data analysis strategy used to test the study's conceptual model are described. The research approach employed in the context of the present study is first described.

The sample is then described, followed by a description of the instrument development and administration.

A description of data analysis methods is discussed, followed by issues of instrument validity and reliability. Lastly, the limitations of the study are highlighted with ethical considerations, and a summary of the chapter provided.

3.2 Research Design

The research design strategy and techniques employed in this study are discussed next.

3.2.1 *Research Approach*

This study used a quantitative approach. This involved using numerical primary data to test an empirical model. It was more appropriate to the current type of relational study where the aim was to examine the effect of pre-identified independent variables on a dependent variable. Quantitative research enables the validation of hypothesised relationships between variables, allowing the researcher to predict phenomena (Leedy & Ormrod, 2005). In using quantitative methods, the researcher is an objective observer independent of the research, as s(he) does not actively participate in the research. This assumes that reality is objective and external to the researcher (Hussey & Hussey, 1997). Moreover, the quantitative research approach supports the formal definition of concepts, deduction of hypotheses, and prediction of outcomes (Hussey & Hussey, 1997; Saunders & Lewis, 2012). This deductive approach to research is used to test if a known theory or phenomenon is valid in given circumstances (Saunders & Lewis, 2012). Qualitative research, however, seeks to explain phenomena by interpreting emerging patterns and themes through non numerical examination (Bailey, 1982; Neuman, 2007)

In the present study, data will be collected and analysed to examine the major factors as hypothesised, in relation to their effect on individual blockchain usage behaviour in organisations. This supports the use of a quantitative deductive approach that is explanatory in nature (Saunders & Lewis, 2012).

This study will seek to explain individual blockchain usage behaviour in organisations, within the empirical context of the South African financial services industry.

3.3 Context of the Study and Sample

The research was limited to individuals employed at the managerial level at a company within the South African Banking and Financial Services Industry (BFSI).

3.3.1 *Unit of Analysis*

The unit of analysis is a classification of the specific unit to be sampled (Terre Blanche et al., 2006). Technical and non-technical managers within the South African banking and financial service industry (BFSI) who through their experiences provided useful insights into individual blockchain usage behaviour in organisations, comprised the target sample (Bhattacherjee, 2012) for the study. As managers within the BFSI, these target respondents possessed the necessary experience and expertise to contribute to the research study.

3.3.2 *Study Population and Sampling Method*

The study of blockchain usage behaviour in organisations requires the insights of those individuals who have an interest in the technology in their respective institutions.

Specific to the topic of this research, a master database of the total population does not exist, but the accessible population of desired respondents commonly found in blockchain and the BFSI use professional networking platforms such as LinkedIn. The researcher, also being well-networked within the industry, obtained through a referral process, respondents who would further attract their respective networks to contribute. This indicates the use of a snowballing method of sampling which is appropriate, given the specialist knowledge required of the respondents (South African financial services and exposure to blockchain either through the course of work or through direct experimentation or implementation). Although snowball sampling carries an inherent risk of selection bias, there is a likelihood of respondent referrals being similar in characteristics and knowledge (Saunders & Lewis, 2012). However, given that the industry and technology under study is specialised, this sampling method was justified for the present study.

The researcher leveraged professional platforms such as LinkedIn to screen and select potential candidates as per the relevant selection criteria. Specifically, a filtration exercise that only displayed managers in banking and financial services within South Africa evidenced ninety-four thousand profiles. The researcher for the purpose of this research, rounded up to a threshold of one-hundred thousand managers who would comprise the accessible population.

When dealing with inter-variable relationships, as a rule of thumb, the formula $N > 50 + 8(m)$ (where m is the number of predictors) can be considered to represent the minimum sample required (Green, 1991), and was used to determine a sample size for this study. In this study, four individual blockchain usage behaviour predictor constructs were examined. Thus, 82 respondents ($N > 50 + 8(4)$) were targeted for the study's sample. However, the researcher sought more responses to enhance the overall response rate. Thus, a total number of 300 was sent from which 160 complete responses were received by the researcher, yielding a response rate of 53%, for data analysis.

3.4 Data Collection

3.4.1 *Research Instrument Construction*

The research instrument construction phase of the study is described. The constructs and the literature sources they were derived from are shown in Table 5.

Table 5 - Constructs and Variables – Chapter 3

Construct	Hypotheses	Supporting Literature Sources	No of dimensions (all scale items measured on 5-point Likert scale)
Perceived Usefulness	H1	(Almekhlafi & Al-Shaibany, 2021; Mohapatra et al., 2015)	4
Motivational Factors	H2	(Mohapatra et al., 2015)	3
Design and Implementation	H3	(Mohapatra et al., 2015; Prewett et al., 2020)	6
Perceived Ease of Use	H4	(Folkinshteyn & Lennon, 2016; Gil-Cordero et al., 2020; Jain et al., 2020; Kamble et al., 2019; Saif Almuraqab, 2020; Shrestha & Vassileva, 2019; Singh et al., 2019; Ullah et al., 2020)	3

As shown in Appendix B, existing scales were adapted from the literature. Four constructs were measured in this study using a questionnaire. A 5-point Likert scale ranging from scores of 1 = Strongly Disagree to 5 = Strongly Agree was used to measure each construct.

Likert scales allow for the variation in responses to be captured, where the level of disagreement or agreement can be elicited. These scales are advantageous as they are easy to use for the respondent from which the answers can be easily coded by the researcher (Hussey & Hussey, 1997).

Variables related to the Perceived Usefulness construct were reflected by respondents' perceptions of the following four dimensions:

First, Streamlining Standardisation of Processes and Policies was reflected as a belief that standardised, streamlined business and IT processes are more likely to be successful in blockchain implementations. Therefore, individuals in organisations driving continuous improvement methodologies and embracing latest technologies to automate processes are more likely to adopt blockchain.

Second, Benefits of the Value Process was reflected as a belief that the achievement of positive business outcomes will positively influence individual blockchain usage behaviour in organisations. Individual users in organisations accustomed to deriving benefits through the employment of technology and exploitation of data are more likely to adopt blockchain.

Third, Digital Product Innovation was reflected as a belief that digital mature organisations that successfully deploy innovative digital products are likely to be adopters of blockchain. This can be measured through innovation in asset trading, and development in digital ecosystems and platforms that ensure a competitive advantage.

Fourth, New Value Streams and Business Models was reflected as a belief that the companies embracing business model disruption through deployment of technology are more likely to adopt blockchain. Individuals in organisations that achieve diversification opportunities and competitive advantage through new value streams advanced by technology are more likely to adopt blockchain.

Variables related to the Motivational Factors construct were reflected by perceptions of the following three dimensions:

First, Rewards and Recognition was reflected as a belief that incentivised individuals will be motivated to adopt blockchain technology in organisations. Recognition or rewards linked to the innovative application of technology by individuals will create an environment that is more receptive to adopting blockchain.

Second, Willingness to Use the New System was reflected as a belief that there should be a willingness in individuals to utilise the system if they are encouraged to do so, hence there will be a likelihood of more blockchain usage in organisations. In the organisational context, individual willingness to use the system is spurred by the encouragement of senior leaders and this drives individual blockchain usage behaviour in organisations.

Third, User Satisfaction was reflected as a belief that as users experience increased satisfaction, their motivation to adopt blockchain technology also increases. Individuals within the organisation context that share their experiences widely either encourage or discourage usage depending on whether the user satisfaction was positive or not.

Variables related to the Design and Implementation construct were reflected by respondents' perceptions of the following six dimensions:

First, Stakeholder Management in the Decision Process was reflected as a belief that inefficient governance becomes an obstacle to blockchain adoption. The involvement of multiple key stakeholders across the various disciplines such as risk, IT, compliance, finance etc., into the design teams, positively influences individual blockchain usage behaviour in organisations.

Second, Effective Review Process by the Senior Management was reflected as a belief that senior management guidance and governance is necessary to increase blockchain adoption. The application of appropriate project and programme governance structures ensure the involvement of senior leaders that clears obstacles to individual blockchain usage behaviour in the organisations.

Third, Training Effectiveness and Skills Imparted was reflected as a belief that organisations that equip employees with the appropriate digital skills are more likely to adopt blockchain. Through effective training and vendor supplementation coupled with effective skills transfer, individual blockchain usage behaviour should increase at the organisational-level.

Fourth, Risk Management was reflected as a belief that due to the very attributes of blockchain technology i.e., disruption of intermediaries, consensus, transparency, etc., there is great scrutiny from a risk and regulatory perspective which becomes an obstacle to adoption. Individual blockchain usage behaviour in the organisation will increase were organisations have, using technology, strengthened their compliance with regulation.

Fifth, Innovation and Investment, was reflected as a belief that digital mature organisations that effectively adopt new technology, invest in, and apply technological tools innovatively. This is measured through the extent of investment in the longer term, and the level of experimentation in the application of technology. Individual blockchain usage behaviour in the organisation is increased where there is more activity regarding investment and innovation.

Sixth, Digital Ethics was reflected as a belief that the application of digital ethics principles ensures the welfare of stakeholders, especially customers. Sound digital ethics practices in design grants confidence to potential adopters, thereby increasing their adoption of blockchain.

Variables related to the Perceived Ease of Use construct were reflected by respondents' perceptions of the following three dimensions:

First, Complexity of the Application was reflected as a belief that the complexity of the application technology makes it difficult and costly to implement. This prospect does not make it a viable option for the organisation. Specific to blockchain, individual blockchain usage behaviour in organisations is increased where experimentation has led to full-scale implementation with relative ease from a technological perspective.

Second, System Working as per the Expectations was reflected as a belief that should the performance expectations of the technology be met, it would encourage blockchain adoption. The measurement of the potential use cases and unintended consequences of blockchain implementation, is indicative of the system performance levels against expectations.

Third, Integration of System was reflected as a belief that a reluctance in replacing legacy systems would influence blockchain adoption, given its characteristic integration over multiple legacy systems. The experiences relating to system integration with blockchain influences individual blockchain usage behaviour in organisations.

Individual Blockchain Usage Behaviour was operationalised as a belief that individuals who have either implemented or plan to implement blockchain soon indicate usage or an intention to use blockchain technology. Strategic prioritisation of blockchain within organisations are indicative of individual blockchain usage behaviour at the organisational-level.

The final paper-based version of the questionnaire (research instrument) is shown in Appendix B.

The use of a structured questionnaire as the research instrument of choice was deemed advantageous. First, it was cost-effective and convenient to develop, and an online survey enables quicker capturing of data for analysis. Second, using an online survey, respondents can exercise greater anonymity than would be possible when physically responding to questionnaires (face-to-face). Third, a questionnaire is suitable for measuring attitudes and perceptions, and allowing for precise information to be elicited using close-ended questions.

In conducting the online survey, the researcher presumed that respondents had online access. In the context of the present study, all respondents had online access.

The next section involves specifying the survey method used for research instrument (questionnaire) administration.

3.4.1 *Administration of the Research Instrument (Survey)*

To ensure the content validity of the instrument, a pre-test was conducted among a selected group of members from the target population. Utilising pre-validated instruments as a foundation for this research ensured a higher degree of design validity (Bailey, 1982). The respondents were specifically requested to critically evaluate the questionnaire and comment on the wording of the questions, identify ambiguity or redundant questions, and give any feedback on potential additional items deemed to enhance the research instrument's quality of measurement. Their feedback was elicited, and minor modifications made to the questionnaire.

The survey was administered during the months of 2021 via an interactive link to the online questionnaire which was posted online on selected networking platforms such as LinkedIn. Respondents were approached through peer networks and the link was forwarded via electronic-mail (e-mail) and mobile messaging platforms such as WhatsApp. The data was stored on a cloud-based platform for analysis.

Each respondent was invited to access the online questionnaire, with a cover letter (Appendix A) used to explain the purpose of the study and assure the confidentiality of the answers. The cover letter also included contact information for anyone who might have had queries or further enquiries. Instructions were also provided on how to complete the questionnaire.

The cover letter was prepared in compliance with the guidelines of the University's ethics committee, and issues such as the risks and benefits invoked, consequences of survey participation, and issues of confidentiality and anonymity, were addressed. Participants were also afforded the option to quit the survey at any time without being adversely affected.

3.5 Data Analysis and Interpretation

The research design employed a quantitative approach that involved a combination of Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) using the IBM SPSS and SmartPLS software packages, respectively, to ensure robust analysis and interpretation of the data.

The obtained data from the survey responses were imported to the IBM SPSS (Version 28) and SmartPLS (Version 3.0) software packages for Windows. The profile of the respondents, descriptive statistics, and Exploratory Factor Analysis (EFA) were analysed using IBM SPSS. SmartPLS was used to conduct a Confirmatory Factor Analysis (CFA) using the Partial Least Squares – Structural Equation Modelling (PLS-SEM) approach. In doing so, a measurement model was tested, allowing for analysis of validity and reliability of model constructs and their underlying dimensions. In addition, a structural path model of was used to analyse the hypothesised relationships of the study's conceptual model (Chapter 2, Figure 11). PLS-SEM is most appropriate for studies where the researcher's aim is to predict and explain target constructs. It is chosen for this research because of its use for hypothetico-deductive prediction. This is consistent with the study objective of explaining hypothesised relationships between variables in the conceptual model (Hair Jr et al., 2017). It is noteworthy that findings from empirical research have indicated that there is a minor difference between PLS-SEM and Covariance – Based Structural Equation Modelling (CB-SEM). As such, results using either approach will not significantly differ (Hair Jr et al., 2017).

3.6 Validity and Reliability

3.6.1 *Validity*

The construct of the blockchain Technology Adoption Model -Organisational (TAMO) is widely supported by the literature as it is observed that organisations that exhibit superior digital transformation and change management principles are successful in leveraging exponential technologies to drive competitive advantage. An Exploratory Factor Analysis (EFA) was conducted via Principal Component Analysis (PCA) (Box et al., 2015). This was followed by a Confirmatory Factor Analysis (CFA), which was used to assess the construct validity (convergence and discriminant). The Average Variance Extracted (AVE) was also assessed, with a value of 0.5 or higher indicating a convergence validity. In addition, the Heterotrait-Monotrait Ratio of Correlations (HTMT) was used to determine the discriminant validity (Henseler et al., 2015).

3.6.2 *Reliability*

The research instrument developed for the study will be replicable where the itemised statements in the questionnaire will be carefully constructed to avoid misinterpretation. The reliability of the factors was assessed with composite reliability, as it measures Construct Reliability (CR) as the internal consistency of the scale items. As a statistical rule of thumb, a value of 0.7 and higher indicates an acceptable reliability of constructs (Hair Jr et al., 2017).

3.7 Limitations of the study

Due to the measurement of the constructs utilising a single source of data, the study may have limitations in the interpretation of the results known as common method bias (Straub et al., 2004). A second limitation could be due to the availability of the respondents being limited due to the timeframe of the study. A third limitation could be due to self-reporting where respondents are subjective or biased and may not have responded objectively (Podsakoff, 2003). A fourth limitation could be due to the survey instrument measuring perceptions of behaviour and not actual behaviour. A fifth limitation of the study could be due to the responses of the participants representing a view elicited at a particular point in time.

Despite these limitations, it is crucial to emphasize the value of the findings obtained in this study. By acknowledging these limitations, the author has taken a cautious approach to the interpretation of the results, ensuring a comprehensive understanding of their implications. The utilization of a single source of data, although susceptible to common method bias, allows for a focused and consistent assessment of the constructs under investigation. Although the limited availability of respondents presents a constraint, the findings are based on a representative sample within the specified timeframe, providing valuable insights into the studied phenomenon.

Moreover, while self-reporting introduces potential subjectivity, it remains an essential method for capturing individual perspectives and perceptions. The survey instrument, despite measuring perceptions rather than actual behaviour, offers valuable insights into the participants' beliefs, attitudes, and intentions, which are crucial for understanding their behaviours in each context. Lastly, while the responses represent a specific point in time which reflects a momentary snapshot of participants' views, they nevertheless contribute to our understanding of their experiences and perspectives within that timeframe.

Therefore, despite its limitations, this study's findings contribute valuable knowledge and insights to the field, enriching our understanding of the phenomenon under investigation.

3.8 Ethical Considerations (Clearance Protocol)

The data was anonymised with any personal details of the participants being removed from the data. The online questionnaire itself was designed only to collect what was necessary in answering the study research questions. Participants were made aware of the research study by means of a letter detailing the study, informing them of the way the data collected were to be used, and obtaining their consent to take part in the research. Ethical clearance (ethics protocol number WBS/DB692930/265) was obtained from the Wits Business School Ethics Committee, constituted under the University Human Research Ethics Committee (Non-Medical).

CHAPTER 4. PRESENTATION OF RESULTS

4.1 Introduction

The research methodology applied in the study was described in the previous chapter. In this chapter, the results of analysis of data collected are discussed. First, screening procedures and sample demographics are discussed. Second, reliability and validity tests with factor analysis as well as descriptive statistics, are discussed. The correlation of independent and dependent variables is also discussed. In concluding the chapter, hypotheses proposed in Chapter 2 via regression analyses are discussed and results presented. Lastly, a summary of the hypotheses which were supported, partially supported, and dropped, are presented.

4.2 Data Screening, outlier, and missing values analysis

4.2.1 *Response Rate*

A structured questionnaire was distributed to 300 respondents from which 160 acceptable responses were collected, yielding a response rate of 53.3%, as shown in Table 6.

Table 6 - Response Rate – Chapter 4

Distributed Questionnaire	Responses	Response Rate
300	160	53.3 (%)

There was a deficit of 140 questionnaires that were not received, and therefore, classified as non-responses for exclusion from the study. The data which were collected via an online survey questionnaire, was first imported to Microsoft Excel, and then exported into IBM SPSS (Version 28.0.1.1). The steps taken to prepare data for analysis comprised three phases. Firstly, the data were searched for missing values. Secondly, the data were examined for outliers. Lastly, the data were examined for normality, which is an underlying statistical assumption in multivariate data analysis (Hair et al., 2010).

4.2.2 *Respondent's Profile*

To identify emergent patterns among respondent managers sampled in the study, a demographic profile was obtained from the data set. The respondent profile (n = 160) of the study is shown in Table 7.

Table 7 - Demographic Information of the Respondents – Chapter 4

Respondent Demographic Profile (n=160)		
Demographic Variable	Frequency	Percentage (%)
Management-Level		
C-suite	9	5.70%
Junior Management	36	22.90%
Middle Management	51	32.50%
Senior Management	61	38.90%
Missing	0	0%
Age		
26 - 41 years	85	53.80%
42 - 57 years	68	43%
58 - 67 years	5	3.20%
Missing	0	0%
Gender		
Female	53	33.50%
Male	105	66.50%
Missing	0	0%
Education		
Diploma Level	29	18.40%
Masters / PHD Level	36	22.80%
Postgrad degree Level	50	31.60%
Secondary School Level	10	6.30%
Undergraduate degree Level	33	20.90%
Missing	0	0%
Experience – Years		
1 - 5 years	9	5.70%
11 - 15 years	36	22.80%
16 - 20 years	33	20.90%
21 - 25 years	28	17.70%
26 and above years	22	13.90%
6 - 10 years	30	19%

Five demographic variables were assessed to profile the respondents. Three were the individual measures gender, age, and highest level of education. The other two were related to the workplace, that is, current level in the organisation and related experience (in years) of the respondent (Table 7).

Most of the respondents were male (66.9%), with females representing 33.1% of the sample. The highest age group comprised respondents between the ages 26 – 41 years (54.4%), followed by the age group 42 – 57 years (42.5%). There was an equitable distribution of the highest education, for those holding a postgraduate degree (31.3%), undergraduate degree (20.6%), and Master's or Doctoral (Ph.D.) degrees (23.8%), respectively. The workplace attributes highlighted that 38.8% consisted of senior management, while 33.1% comprised middle management, with 22.5% representing junior management. The executive ("C-suite") category comprised 5.63% of respondents.

As shown in Table 7, the respondents had varying levels of experience where those with 11 – 15 years comprised 23.8% of the sample, followed by respondents with 16 – 20 years (20.6%), and the smallest group with 1 – 5 years (5.63%).

4.2.3 *Missing Value Analysis*

The missing data replaced with the series mean for all predictor (independent) and criterion (dependent) variables is presented in Table 8.

Missing data can be observed as the number of cases with missing data per variable and the number of variables with missing data per case (Hair et al., 2010). From a variable perspective, no missing data were found, however in analysing the entire data set missing data were found at the case level.

In order to hold the sample size and confirm that all cases had complete data, missing values was replaced with the series mean for the specific variable across the entire data set (Hair et al., 2010).

The mean substitution method was used to replace the series mean for missing values. However, for cases 23 and 147, the missing values exceeded 10% (Hair et al., 2010), hence they were excluded from the study. As a result, the sample population taken into the study was 158.

Table 8 - Missing Data Analysis – Chapter 4

Missing Data			
Variable	Measurement Item	Number of Missing Values	Replaced with Series Mean
Organisational Usage Behaviour	IBUB1_1	0	-
	IBUB2_1	0	-
	IBUB3_1	0	-
Streamlining, standardisation of processes, and practices	SSPP1_1	2	Yes
	SSPP2_1	1	Yes
	SSPP3_1	0	-
Benefits of the process	BP1_1	0	-
	BP2_1	0	-
Digital Product Innovation	DPI1_1	0	-
	DPI2_1	0	-
	DPI3_1	0	-
New Value Streams and Business Models	NVSB1_1	4	Yes
	NVSB2_1	0	-
	NVSB3_1	0	-
Rewards and recognition	RR1_1	0	-
Willingness to use the new system	WUNS1_1	0	-
User satisfaction	US1_1	1	Yes
	US2_1	0	-
Stakeholder management in the decision process	SMDP1_1	0	-
Effective review process by senior management	EEPSM1_1	1	Yes
Training effectiveness and skills imparted	TESI1_1	0	-
	TESI2_1	0	-
Risk Management	RM1_1	0	-
	RM2_1	1	Yes
Innovation and investment	II1_1	0	-
	II2_1	0	-
Digital ethics	DE1_1	0	-
Complexity of the application - blockchain specific	COA1_1	0	-
	COA2_1	0	-
System working as per the expectations	SWPE1_1	0	-
	SWPE2_1	0	-
Integration of system	IS1_1	0	-
	IS2_1	0	-

4.2.4 *Outlier Analysis*

The univariate method for outlier detection was used to analyse data. Using this method, the data values are converted to standard scores, and a threshold for selection of an outlier established (Hair et al., 2010). Accordingly, in small samples (less than or equal to 80), a standard score of 2.5 or greater is used (Hair et al., 2010). In larger sample sizes, the score is increased to 4 (Hair et al., 2010). The study sample comprised 158 responses. Hence a threshold of 4 was used to identify outliers. An inspection of the data set revealed that there were no extreme values identified.

4.2.5 *Normality*

The descriptive statistics obtained for the predictor (independent) and criterion (dependent) variables, are summarized in Table 9.

Table 9 - Descriptive Statistics – Chapter 4

Descriptive Statistics						
Variable	Measurement Item	Number of Missing Values	Mean	Standard Deviation	Skewness	Kurtosis
Organisational Usage Behaviour	IBUB1_1	0	3.424	1.2172	-0.368	-0.816
	IBUB2_1	0	3.063	1.2853	-0.083	-0.971
	IBUB3_1	0	3.475	1.1382	-0.436	-0.499
Streamlining. standardisation of processes. and practices	SSPP1_1	0	4.417	0.7135	-1.033	0.518
	SSPP2_1	0	4.242	0.8325	-0.953	0.328
	SSPP3_1	0	4.443	0.6629	-0.785	-0.472
Benefits of the process	BP1_1	0	4.285	0.7409	-0.607	-0.607
	BP2_1	0	4.335	0.8108	-1.051	0.399
Digital Product Innovation	DPI1_1	0	3.949	0.9293	-0.622	0.014
	DPI2_1	0	4.285	0.7988	-1.016	0.625
	DPI3_1	0	4.38	0.7705	-1.112	0.693
New Value Streams and Business Models	NVSB1_1	0	4.506	0.5999	-0.832	-0.23
	NVSB2_1	0	4.228	0.7647	-0.846	0.511
	NVSB3_1	0	3.766	0.9979	-0.293	-0.824
Rewards and recognition	RR1_1	0	3.854	1.0395	-0.738	-0.04
Willingness to use the new system	WUNS1_1	0	4.025	0.8517	-0.55	-0.356
User satisfaction	US1_1	0	4.108	0.7947	-0.584	-0.177
	US2_1	0	3.994	0.9807	-0.726	-0.28

Stakeholder management in the decision process	SMDP1_1	0	4.215	0.9331	-1.206	1.101
Effective review process by the senior management	EEPSM1_1	0	4.089	0.8474	-0.618	-0.32
Training effectiveness and skills imparted	TESI1_1	0	3.253	1.1888	-0.089	-0.906
	TESI2_1	0	3.291	1.1746	-0.227	-0.704
Risk Management	RM1_1	0	4.348	0.7814	-1.025	0.43
	RM2_1	0	4.185	0.8357	-0.76	-0.139
Innovation and investment	II1_1	0	3.468	1.1927	-0.38	-0.704
	II2_1	0	3.981	1.0062	-0.874	0.223
Digital ethics	DE1_1	0	4.481	0.7797	-1.569	2.044
Complexity of the application - blockchain specific	COA1_1	0	3.038	1.0151	0.293	-0.457
	COA2_1	0	3.114	1.0093	-0.043	-0.325
System working as per the expectations	SWPE1_1	0	2.62	1.1977	0.343	-0.716
	SWPE2_1	0	2.867	0.9846	0.149	-0.224
Integration of system	IS1_1	0	3.07	1.1572	-0.012	-0.749
	IS2_1	0	3.329	1.0734	-0.252	-0.436

Normality, which refers to the distribution of data per individual metric variable and its correspondence to the normal distribution, is a fundamental assumption of multivariate analysis (Hair et al., 2010).

All the variables were appropriate since their skewness and kurtosis values fell within - 2 and + 2 for skewness and - 3 and + 3 for kurtosis ranges, respectively (Hair et al., 2010).

4.3 Preparation for Factor Analysis

4.3.1 *Factorability*

In assessing the construct dimensions for factor analysis, all the independent variables were inter-correlated to evaluate suitability (Hair et al., 2010). Factor analysis is suitable in inspection of the emergent correlation matrix and displays no substantial number of correlations above 0.30 (Hair et al., 2010). Factorability of the data is diminished when there is inter-correlation with a score less than 0.30 of an item with another within the same construct and therefore must be excluded prior to factor analysis.

Perceived Usefulness, in terms of factorability SSPP1, SSPP2, and SSPP3 inter-correlated with values greater than 0.300. Therefore, these items were retained. BP1, BP2 inter-correlated with values greater than 0.300 therefore the items were retained. The dimensions DPI1, DPI2, and DPI3 inter-correlated with values higher than 0.3000, and was retained. NVSB1, NVSB2, NVSB3, intercorrelated with values higher than 0.300 and were retained. Motivational Factors in terms of factorability, only US1 and US2 was inter-correlated as it contained 2 scale items. RR and WUNS1 could not and contained 1 item each and would have to be considered for inclusion post-EFA. In terms of Design and Implementation, TESI 1, TESI 2, RM 1, RM 2, II1, and II2 inter-corelated with higher values above 0.300. Hence, these items were retained. However, SMDP1, EEPSM1 having single items could not be inter-corelated and had to be isolated. The optimal solution for Perceived Ease of Use comprised COA1 and COA2 since SWPE1, SWPE2, IS1, and IS2, cross loaded.

4.3.2 *Test for Common Method Bias*

To assess the commonality of the variance in variables that use Exploratory Factor Analysis or (EFA), Harman's Single factor test was applied (Podsakoff & Organ, 1986). Common method bias is detected if a single factor that explains over 50% of the variance for all variables (Podsakoff & Organ, 1986). Table 10 presents the results of Harman's (1976) Single Factor Test

Table 10 - Results of Harman's (1976) Single-Factor Test – Chapter 4

Results of Harman's (1976) Single-Factor Test						
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.168	33.842	33.842	11.168	33.842	33.842
2	3.352	10.156	43.999	3.352	10.156	43.999
3	2.869	8.695	52.693	2.869	8.695	52.693
4	1.716	5.201	57.894	1.716	5.201	57.894
5	1.239	3.753	61.647	1.239	3.753	61.647
6	1.174	3.557	65.205	1.174	3.557	65.205
7	1.027	3.113	68.317	1.027	3.113	68.317

A total of 33 variables across the dimensions of Perceived Usefulness, Motivational Factors, Design and Implementation, Perceived Ease of Use, and the dependent variable Individual Blockchain Usage Behaviour, were analysed via Principal Component Analysis (PCA) which was unrotated. Within Table 10, 11 emergent factors had Eigen values greater than 1.000 and accounted for 68.317% of the combined variance in the variables (Hair Jr et al., 2014). No single factor explained over 50% of the variance. Therefore, there was no detection of common method bias.

4.4 Exploratory Factor Analysis (EFA)

The primary method of factor analysis used was Principal Component Factor Analysis (PCA), with Promax orthogonal rotation and where Kaiser normalisation was put into use, where factors and variables were reduced. According to Hair et al (2010) recommendation, the factors should be interpreted as follows (Hair et al., 2010). Factors were interpreted as follows:

1. Items have high loadings on a single factor.
2. Those that load on two or more factors are deleted unless theoretically proven or if there is strict objective applied to the data reduction.
3. Items of 0.50 or more communalities are to be retained for further analysis.
4. The items load onto out of the unlikely factors.

The items excluded from the study for each of the constructs, are displayed in Table 11.

Table 11 - Items Excluded after PCFA – Chapter 4

Construct	No. of Initial Items	No. of Retained Items	Items excluded	Rationale
Perceived Usefulness	8	3	BP1_1	Cross-loaded onto another factor
			BP2_1	Cross-loaded onto another factor
			DPI1_1	Cross-loaded onto another factor
			DPI2_1	Cross-loaded onto another factor
			DPI3_1	Cross-loaded onto another factor
Motivational Factors	7	2	NVSB1_1	Inclusion reduces factorability of Data

			NVSB2_1	Inclusion reduces factorability of Data
			NVSB3_1	Inclusion reduces factorability of Data
			RR1_1	Cross-loaded onto another factor
			WUNS1_1	Cross-loaded onto another factor
Design and Implementation	9	4	SMDP1_1	Cross-loaded onto another factor
			EEPSM1_1	Cross-loaded onto another factor
			II1_1	Inclusion reduces factorability of Data
			II2_1	Inclusion reduces factorability of Data
			DE1_1	Cross-loaded onto another factor
Perceived Ease of Use	6	2	SWPE1_1	Cross-loaded onto another factor
			SWPE2_1	Cross-loaded onto another factor
			IS1_1	Cross-loaded onto another factor
			IS2_1	Cross-loaded onto another factor

The Exploratory Factor Analysis (EFA) requires two approaches i.e., extraction and rotation, and it was used to determine the one-dimensionality of each variable.

Through extraction the information was summarized within several variables into fewer variates (factors) or dimensions with minimal lost data. The second approach rotation, helped in re-allocating the factor variance to obtain a simpler, more meaningful theoretical configuration. The Promax method was selected for rotation in EFA. The extraction method used was PCA with Promax selected for rotation. Hence, PCA factor extraction with Promax rotation was utilised.

To determine the factor loadings' practical significance, factor loadings must be evaluated against three conditions.

First, items should have high loadings above 0.300 for a sample size greater than 350 (Hair et al., 2010). Second, items that have loadings on two or more factors (cross-load) are ruled out except when theoretically justified (Hair et al., 2010). The items should generally exceed 0.500 in item communalities.

To confirm the appropriateness of the factor analysis, Bartlett's Test of Sphericity and the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy were also used (Pallant, 2010).

The optimal solution for the dimensions of Perceived Usefulness is presented in Table 12:

Table 12 - Results Principal Component Analysis (PCA) - Perceived Usefulness – Chapter 4

Principal Component Analysis (PCA) Result: Perceived Usefulness (PU)	
Item	Factor
	1
SMEAN(SSPP1)	0.819
SMEAN(SSPP2)	0.831
SMEAN(SSPP3)	0.864

To achieve the optimal solution for Perceived Usefulness (PU), four runs were required. The results of the first run displayed low communality scores for the dimension DP1, and the dimension BP1 was cross-loading onto to the SSPP dimension. Through a process of elimination, it was found that perceived usefulness is best represented by SSPP1, SSPP2, and SSPP3, as it had high communality scores, and explained 70%.

Table 13 - Results of Total Variance Explained by the Dimensions (variables) of Perceived Usefulness – Chapter 4

Total Variance Explained: Perceived Usefulness (PU)						
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.109	70.301	70.301	2.109	70.301	70.301
2	0.500	16.682	86.982			
3	0.391	13.018	100.000			
Extraction Method: Principal Component Analysis.						

The dimensions of Perceived Usefulness comprised 3 items. Factor 1 had an eigen value of 2.109 (>1) and explained 70.301% of the variance. The optimal solution for the dimensions of Motivational Factors is presented in Table 14:

Table 14 - Principal Component Analysis (PCA) Results: Motivational Factors – Chapter 4

Principal Component Analysis (PCA) Results: Motivational Factors	
Item	Factor
	1
SMEAN(US1)	0.858
SMEAN(US2)	0.858

The optimal solution for Motivational Factors is represented by US1 and US2 since it had the highest communality scores, the strongest loading scores and explained 73% of the variance.

Table 15 - Results of Total Variance Explained by the Dimensions (variables) of Motivational Factors – Chapter 4

Total Variance Explained: Motivational Factors (MF)						
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,473	73.656	73.656	1.473	73.656	73.656
2	0.527	26.344	100.000			
Extraction Method: Principal Component Analysis.						

The dimensions of motivational factors comprised 2 items. Factor 1 had an eigen value of 1.473 (>1) and explained 73.656% of the variance.

The optimal solution for the dimensions of Design and Implementation is presented in Table 16:

Table 16 - Principal Component Analysis Result: Design and Implementation – Chapter 4

Principal Component Analysis Result: Design and Implementation	
Item	Factor

	1	2
SMEAN(TESI1)	0.932	
SMEAN(TESI2)	0.942	
SMEAN(RM1)		0.918
SMEAN(RM2)		0.894

It was found that the dimensions II1 and II2 were loading onto the same component as TES1 and TESI2. Further inspection showed lower communalities for II2. It was therefore excluded. The optimal solution included TESI1, TESI2, RM1, and RM2 which loaded correctly and had high factor loading scores.

Table 17 - Results of Total Variance Explained by the Dimensions (variables) of Design and Implementation – Chapter 4

Total Variance Explained: Design and Implementation (DI)							
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	2.393	59.824	59.824	2.393	59.824	59.824	2.036
2	1.019	25.487	85.311	1.019	25.487	85.311	1.920
3	0.365	9.129	94.440				
4	0.222	5.560	100.000				
Extraction Method: Principal Component Analysis.							
a. When components are correlated. sums of squared loadings cannot be added to obtain a total variance.							

The dimensions of Design and Implementation comprised 4 items. Factor 1 had an eigen value of 2.393 (>1) and factor 2 had an eigen value of 1.019. Collectively they explained 85.311% of the variance.

The optimal solution for the dimensions of Perceived Ease of Use is presented in Table 18.

Table 18 - Principal Component Analysis Result: Perceived Ease of Use – Chapter 4

Principal Component Analysis (PCA) Results: Perceived Ease of Use	
Item	Factor

	1
SMEAN(COA1)	0.896
SMEAN(COA2)	0.896

The optimal solution for Perceived Ease of Use was best represented by COA1 and COA2. The dimensions COA1, COA2, SWPE1, SWPE2, IS1, and IS2 loaded onto the same component. Through a process of elimination, it was found that COA1 and COA2 explained the most variance of 80.249% with high factor loadings.

Table 19 - Results of Total Variance Explained by the Dimensions (variables) of Perceived Ease of Use – Chapter 4

Total Variance Explained: Perceived Ease of Use (PU)						
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.605	80.249	80.249	1.605	80.249	80.249
2	0.395	19.751	100.000			
Extraction Method: Principal Component Analysis.						

The dimensions of Perceived Ease of Use comprised 2 items. Factor 1 had an eigen value of 1.605 (>1) and explained 80.249% of the variance.

4.5 Reliability and Validity

Each construct showed that the items were highly loaded up to more than 0.35. In addition, there were no cross-loaded items compared to other factors. To further examine the consistency and reliability of the revised scale, the Cronbach’s Coefficient Alpha Value was applied. The threshold value of 0.700 is considered appropriate for items to be deemed reliable (Nunnally, 1994). The results revealed acceptable reliability scores (>0.700) and was retained for further study. All variables exhibited discriminant and convergent validities. AVE was used to compute the discriminant and convergent validity as measured by the following formula:

$$AVE = \frac{\sum[\lambda_i^2]Var(X)}{\sum[\lambda_i^2]Var(X)+\sum[Var(\varepsilon_i)]}$$

where:

$_i$ = The Loading of x_i on X

Var = Variance

ε_i = The Measurement Error of x_i

$\sum$ = Denotes a Sum

(Fornell & Larcker, 1981)

The construct validities and reliabilities of Perceived Usefulness, Motivational Factors, Design and Implementation, and Perceived Ease of Use are presented in Table 20.

Table 20 - Instrument (Construct) Validities and Reliabilities – Chapter 4

Instrument (Construct) Validities and Reliabilities					
Variable (Dimension)	**Scale Items**	**No of Items**	**Cronbach's Alpha**	**AVE**	**SQRT AVE**
Perceived Usefulness	SSPP1	3	0.782	0.702	0.838
	SSPP2				
	SSPP3				
Motivational Factors	US1	2	0.633	0.736	0.858
	US2				
Design & Imp	TESI1	2	0.863	0.877	0.937
	TESI2				
	RM1	2	0.781	0.816	0.906
	RM2				
Perceived Ease of Use	COA1	2	0.754	0.803	0.896
	COA2				

The acceptable threshold AVE value of at least 0.500 is acceptable for convergent validity to be established. In addition, the Square Root of the AVE (SQRT AVE) was computed to establish corresponding discriminant validity. Therefore, overall reliabilities and convergent and discriminant validity were confirmed (Fornell & Larcker, 1981).

4.6 Descriptive Statistics for Composites

The descriptive statistics for composite scores are presented in Table 21. The standard deviation scores were close to 1 indicating consistency in terms of responses (Hair et al., 2010). In keeping with the acceptable range for skewness and kurtosis i.e. -1 to +1 and -3 to +3 respectively, all values were acceptable (Hair et al., 2010).

Table 21 - Descriptive Statistics for Composites – Chapter 4

Descriptive Statistics for Composites						
Variable	N Statistic	Number of Missing Values	Mean	Standard Deviation	Skewness	Kurtosis
IBUB	158	0	3.320	1.079	-.328	-.556
PU	158	0	4.300	.704	-.903	.375
MF	158	0	4.051	.763	-.466	-.541
DITESI	158	0	3.272	1.108	-.252	-.758
DIRM	158	0	4.266	.732	-.736	-.258
PEOUCOA	158	0	3.075	.906	.102	.008
PEOSWPE	158	0	2.743	.955	.233	-.397

Pearson's Test of Correlations							
	PU	**MF**	**DITESI**	**DIRM**	**PEOUCOA**	**PEOUSWPE**	**IBUB**
PU	1	.559**	.373**	.474**	-0,023	-0,007	.310**
MF	.559**	1	.465**	.526**	-0,038	-0,109	.282**
DITESI	.373**	.465**	1	.406**	-0,022	-0,084	.773**
DIRM	.474**	.526**	.406**	1	0,079	-0,079	.275**
PEOUCOA	-0,023	-0,038	-0,022	0,079	1	.592**	-0,015
PEOUSWPE	-0,007	-0,109	-0,084	-0,079	.592**	1	-.172*
IBUB	.310**	.282**	.773**	.275**	-0,015	-.172*	1

4.7 Pearson's Test of Correlation

The variables of the study were tested for correlations using a Pearson's test and the results are displayed in table 22.

Table 22 - Results of Pearson's Test of Correlations – Chapter 4

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

The correlation matrix highlighted significant inter-correlations between the variables. Some bivariate relationships were inter-correlated but were, however, not found to be insignificant.

The variables were estimated using the calculated latent variable (average) scores of their respective dimensions as follows, PU comprised scores for dimensions SSPP1, SSPP2, and SSPP3, MF comprised scores for dimensions US1 and US2, DITESI comprised scores for dimensions TESI1 and TESI2, DIRM comprised scores for dimensions RM1 and RM2, PEOUCOA comprised scores for dimensions COA1 and COA2, and IBUB comprised scores for dimensions IBUB1, IBUB2, and IBUB3, respectively.

The sole aim of the study was to evaluate the relationships of the variables even though bivariate correlations can be used to demonstrate their associations. Since Pearson's test of correlation is insufficient for testing the variable inter-correlations, the study is more appropriate to the more robust SEM (Hair Jr et al., 2017). Therefore, the structural path model was utilised as the preferred method with which to evaluate the study in terms of the objectives set out in Chapter 1, and the hypothesised relationships proposed in Chapter 2.

4.8 Evaluation of the Structural Path Model

The evaluation of the structural path model includes assessing the model's prediction abilities as well as the relationships between the constructs, or more specifically, the relationships proposed in the conceptual model of this work (Hair Jr et al., 2017). After a successful evaluation of the measurement model, in which the validity and reliability of the measures of the latent variables (constructs) were established, the structural path model is assessed. A methodical, sequential strategy was used to investigate the structural path model.

4.8.1 *Testing for Collinearity*

The estimation of path coefficients for dependent variables should not be affected by levels of substantial collinearity across predictor variables. Hence, collinearity testing is crucial (Hair Jr et al., 2014). Table 23 displays the results of the test for collinearity.

Table 23 - Test for Collinearity – Chapter 4

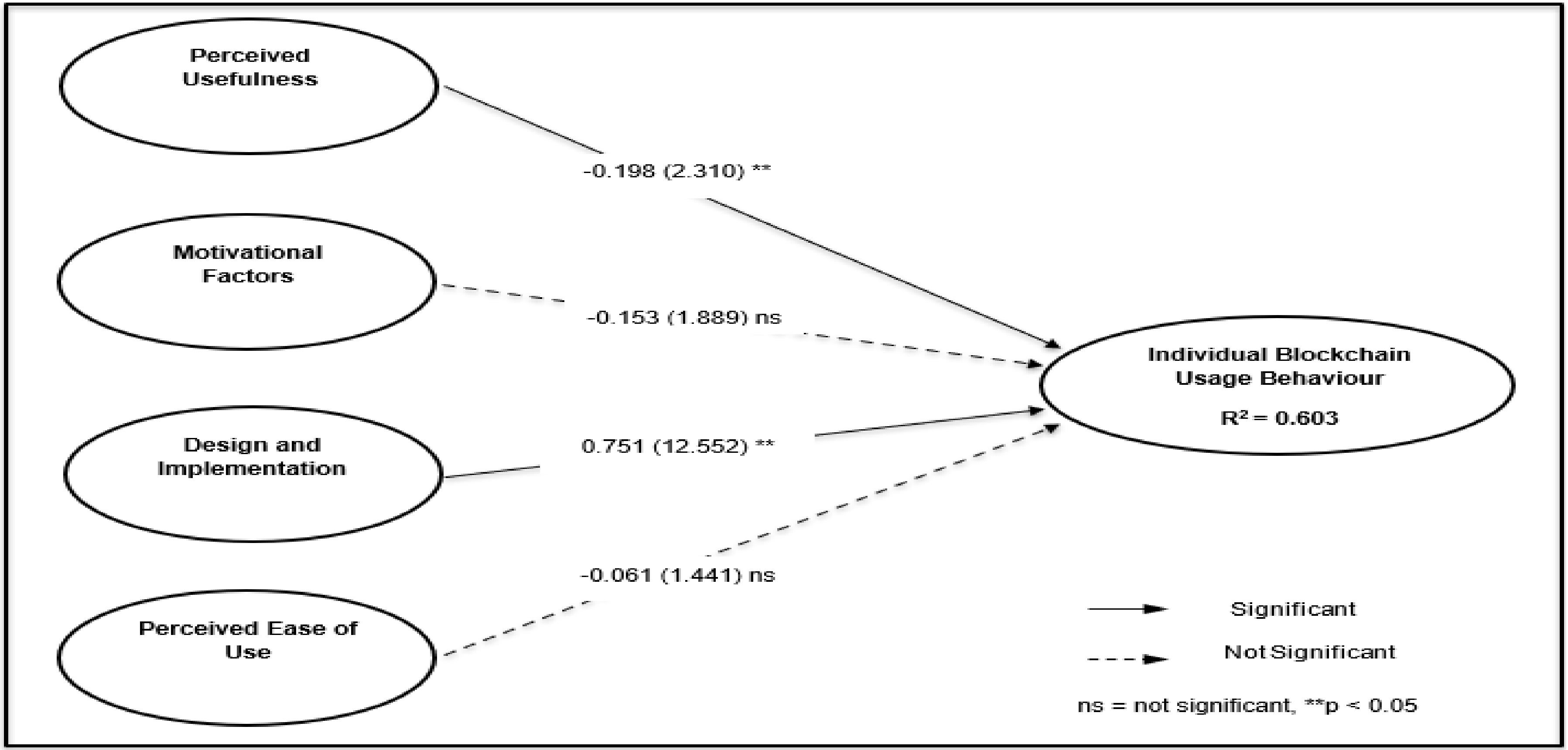
Results of Test for Collinearity		
Criterion: Individual Blockchain Usage Behaviour		
Predictor	Tolerance	VIF
Perceived Usefulness	0.778	1.285
Motivational Factors	0.609	1.643
Design and Implementation	0.978	1.023
Perceived Ease of Use	0.639	1.565

The tolerance values were greater than 0.200, and the VIF values less than 5.000, well within the acceptable thresholds (Hair Jr et al., 2014). Collinearity between predictor components in the path model was, therefore, not viewed as a problem in this investigation.

4.8.2 *Estimation of the Structural Path Coefficients*

The effect of determinants, represented by Perceived Usefulness, Motivational Factors, Design and Implementation, and Perceived Ease of Use, on Individual Usage Behaviour at the Organisational level, was assessed using a structural path model. Path coefficients were assessed to determine the relative strengths of the paths in the structural path model. Using a non-parametric bootstrapping technique, it was determined empirically whether the structural model path coefficients of the hypothesized correlations were significant (Davison & Hinkley, 1997; Efron & Tibshirani, 1986; Hair Jr et al., 2014). Through this method, a standard error was obtained to estimate the significance of path coefficients. The path coefficients of the structural model were then evaluated for significance using the t and p values (Hair Jr et al., 2014; Hair Jr et al., 2017). Critical t values were utilized to interpret statistical significance levels. In this case, this was deemed as 1.96 for a significance level of 5 % ($\alpha = 0.05$, two-tailed test) (Hair Jr et al., 2017). Bootstrapped confidence intervals were obtained using the Bias-Corrected and Accelerated (BCa) technique to provide further information on the stability of the calculated coefficients. The bootstrap confidence interval specifies the range within which the true population parameter lies under the assumption of a given level of confidence by using standard errors from bootstrapping (Hair Jr et al., 2017). To determine whether the path coefficients significantly deviated from zero, a bootstrap confidence interval of 95% was utilized (Hair Jr et al., 2017). As a result, it was anticipated that the confidence intervals for a calculated path coefficient that excluded zero had a substantial impact. Figure 13 shows the structural path model that was estimated to test the relationship between Individual Blockchain Usage behaviour and its predictors (determinants) represented by Perceived Usefulness, Motivational Factors, Design and Implementation, and Perceived Ease of Use.

Figure 13: Structural Path Model (n = 158) – Chapter 4



Effects
*Perceived Usefulness → Individual Blockchain Usage Behaviour (path coefficient = -0.198, t = 2.310, p < 0.05) ***
Motivational Factors → Individual Blockchain Usage Behaviour (path coefficient = 0.153, t = 1.889, p < 0.05) ns
*Design and Implementation → Individual Blockchain Usage Behaviour (path coefficient = 0.751, t = 12.552, p < 0.05) ***
Perceived Ease of Use → Individual Blockchain Usage Behaviour (path coefficient = -0.061, t = 1.441, p < 0.05) ns

Table 24 - Results of Significance Testing of the Structural Path Model Coefficients – Chapter 4

Significance Testing of the Structural Path Model Coefficients					
Path	**Path Coefficient**	**t value**	**p value**	**Sig. Level**	**95% CI**
Perceived Usefulness → Individual Blockchain Usage Behaviour	-0.198	2.310	0.021	**	[-0.378, -0.040]
Motivational Factors → Individual Blockchain Usage Behaviour	-0.153	1.889	0.059	ns	[-0.299, 0.014]
Design and Implementation → Individual Blockchain Usage Behaviour	0.751	12.552	0.000	**	[0.622, 0.857]
Perceived Ease of Use → Individual Blockchain Usage Behaviour	-0.061	1.441	0.150	ns	[-0.0144, 0.022]

ns = not significant, **$p < 0.05$ ($t > 1.96$)

The results in Table 24 indicate that Design and Implementation had the most salient significant and positive relationship with Individual Blockchain Usage Behaviour (path coefficient = 0.751, t = 12.552, p < 0.000). There was also no absolute zero value, as shown by the bootstrapping confidence interval. Perceived Usefulness had a significant and negative relationship with Individual Blockchain Usage Behaviour (path coefficient = -0.198, t = 2.310, p < 0.021). There was also no absolute zero value, as shown by the bootstrapping confidence interval.

Motivational Factors was not shown to significantly affect Individual Blockchain Usage Behaviour, in contrast to the predicted theorized hypothesis (path coefficient = -0.153, t= 1.889, ns). The similar observation was made for Perceived Ease of Use which showed no significance in contrast to the formulated hypothesis (path coefficient = -0.061, t= 1.441, ns). In both cases, an absolute zero value was observed within the bootstrapping confidence interval.

Table 25 displays the summary of the hypotheses testing results.

Table 25 - Summary of Results of Hypotheses Testing – Chapter 4

Summary of Results of Hypothesis Testing		
	Hypothesis	**Results**
H1	Perceive Usefulness has a positive influence on individual blockchain usage behaviour at the organisational-level.	Not Supported

H2	Motivational Factors has a positive influence on individual blockchain usage behaviour at the organisational-level.	Not Supported
H3	Design and Implementation has a positive influence on individual blockchain usage behaviour at the organisational-level.	Supported
H4	Perceived Ease of Use has a positive influence on individual blockchain usage behaviour at the organisational-level.	Not Supported

4.8.3 *Coefficients of Determination (R^2 Value)*

The coefficient of determination (R^2 value), which is derived as the squared correlation between a certain criterion (dependent) variable's anticipated and actual values, is used to assess the estimated structural path model's predictive efficacy (Hair Jr et al., 2014; Hair Jr et al., 2017). This value denotes the total impact of the predictor variables on the outcome variable. The R^2 values range from 0 to 1, with larger values indicating higher levels of prediction accuracy (Hair Jr et al., 2014). For dependent (criteria) variables, Chin (1998) and Ringle (2004) suggested the R^2 value thresholds of 0.670 (substantial), 0.333 (moderate), and 0.190 (weaker), respectively (Chin, 1998; Ringle, 2004). These R^2 value thresholds, particularly in the social sciences and associated research, are open to interpretation and may not necessarily be conclusive (Hair Jr et al., 2014). For instance, R^2 values of 0.200 or more are regarded as extremely significant in studies on Consumer Behaviour, whereas those of 0.750 or higher are deemed high in disciplines such as Marketing (Hair Jr et al., 2014).

Individual Blockchain Usage Behaviour's coefficient of determination (R^2 value), which corresponds with this dependent (criterion) variable, is shown in Table 26.

Table 26 - Result of R^2 Value of Dependent (Criteria) Variable – Chapter 4

R^2 Value of Dependent (Criteria) Variable	
Dependent (Criterion) Variable	**R^2 Value**
Individual Blockchain Usage Behaviour	0.603

According to the findings presented in Table 26, the estimated structural path model has a highly significant level of predictive accuracy for the dependent (criterion) variable Individual Blockchain Usage Behaviour (R^2 = 0.603).

4.8.4 *Effect Size (f^2)*

The calculation of an f^2 effect size was implemented in addition to the evaluation of the overall R^2 value. When a certain predictor (independent) variable is excluded from the structural path model, the R^2 value of the dependent (criterion) variable changes. This change is measured by the f^2 effect size. Consequently, it is evaluated based on how or whether the eliminated independent variable affected the dependent variable (Hair Jr et al., 2014; Hair Jr et al., 2017).

The following formula is used to compute the f^2 effect.

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}}$$

The dependent variable's R^2 values when a specific independent (predictor) variable is either included or omitted from the path model are referred to as R^2 included and R^2 excluded, respectively (Hair Jr et al., 2017). The changes in the R^2 values were estimated to calculate the f^2 effect magnitude. The path model was estimated twice to produce the f^2 effect.

First, the independent (predictor) variable was incorporated in the path model estimation (yielding $R^2_{included}$). Second, the independent variable (yielding $R^2_{excluded}$) was omitted from the path model estimation. Cohen (1988) value thresholds were applied to interpret the f^2 effect size obtained using the formula above (Cohen, 1988). A specific independent predictor is said to have a modest, medium, or large effect on the dependent (criterion) variable, if its f^2 value falls between 0.020 and 0.150, between 0.150 and 0.350, or is higher than 0.350, respectively. The predictive structural path model's f^2 effect sizes are shown in Table 27.

Table 27 - Results of f^2 Effect Sizes for Dependent Variables – Chapter 4

Results of f2 Effect Sizes for Dependent (Criteria) Variables					
Independent (Predictor) Variable	**Dependent (Criterion) Variable**	**R^2 included**	**R^2 excluded**	**f^2 effect size**	**Interpretation**
Perceived Usefulness		0.603	0.577	0.065	Small effect
Motivational Factors		0.603	0.588	0.038	Small effect

Design and Implementation	Individual Blockchain Usage Behaviour	0.603	0.163	1.108	Large effect
Perceived Ease of Use		0.603	0.599	0.010	No effect

According to the findings presented in Table 27, Perceived Usefulness had a small effect (0.065) on Individual Blockchain Usage Behaviour. Additionally, Motivational Factors were found to have a small effect on Individual Blockchain Usage Behaviour (0.038). Furthermore, Design and Implementation had a large effect on Individual Blockchain Behaviour (1.108). Perceived Ease of Use, however, had a negligible effect on Individual Blockchain Usage Behaviour (0.010).

4.8.5 *Predictive Relevance (Q^2 Value)*

To determine the predictive relevance of the calculated structural path model, the Stone-Q^2 Geisser's value (Geisser, 1974; Stone, 1974) was evaluated in addition to predictive accuracy (R^2) (Hair Jr et al., 2017). Through the use of blindfolds and a predetermined omission distance, D, the Q^2 value for the path model was determined (Hair Jr et al., 2017). Blindfolding techniques are applied to dependent (criteria) variables that make up a reflective (mode A) specification of the measurement model (Hair Jr et al., 2017). The model's significant predictive relevance for a particular dependent (criterion) variable is indicated by Q^2 values above 0.000. On the other hand, Q^2 values of 0.000 or lower indicate a lack of predictive relevance (Hair Jr et al., 2017; Urbach & Ahlemann, 2010). The endogenous constructs of Perceived Usefulness, Motivational Factors, Design and Implementation, and Perceived Ease of Use, were computed for this study using Stone-Q^2 Geisser's values (Geisser, 1974; Stone, 1974). Data points in the measurement model of reflective dependent (criterion) variables were estimated using a two-step process in this procedure, which was based on a cross-validated redundancy approach. In the beginning, scores of the independent (predictor) variables were used to predict scores of the dependent (criteria) variables, and their structural model path coefficients were derived using the PLS-SEM approach. In the subsequent stage, the data points of its indicators that were left out of the measurement model were systematically anticipated using the predicted scores of the reflective dependent (criterion) variable. The omission distance

(D), which is used to execute the blindfolding process, is what determines the systematic pattern of removing and predicting the data points.

The actual and predicted values were then compared using the blindfolded results to determine the estimated predictive significance of the structure route model. Table 28 displays the results.

Table 28 - Result of Q^2 Values of Dependent Variable – Chapter 4

Results of Q^2 Value of Dependent (Criteria) Variable	
Dependent (Criterion) Variable	**Q^2 Value**
Individual Blockchain Usage Behaviour	0.547

According to the findings presented in Table 28, the dependent (criterion) variable Individual Blockchain Usage Behaviour (0.547), was found to exhibit significant predictive relevance.

4.8.6 *Effect Size (q^2)*

The calculation of the q^2 effect size was done in addition to the Q^2 value evaluation. A measure of the predictor's (independent) contribution to the criterion's (dependent) Q^2 value is the q^2 effect size (Hair Jr et al., 2014; Hair Jr et al., 2017). To determine the relevant impact of Perceived Usefulness, Motivational Factors, Design and Implementation, and Perceived Ease of Use, on the estimated structural path model's predictive relevance Q^2, the q^2 effect was manually calculated for the current study. The PLS-SEM algorithm, it should be noted, does not offer q^2 effect size values. As a result, manual computation was required. Predictive relevance values of 0.02, 0.15, and 0.35 respectively, indicate that the independent variable has a minor, medium, or substantial impact on the estimated structural path model's predictive relevance Q^2 for a particular dependent (criterion) variable (Hair Jr et al., 2014; Hair Jr et al., 2017). The formula below was used to calculate the q^2 effect size:

$$q^2 = \frac{Q^2_{included} - Q^2_{excluded}}{1 - Q^2_{included}}$$

Values for $Q^2_{included}$ and $Q^2_{excluded}$ were derived using the PLS-SEM findings. To be more precise, $Q^2_{included}$ values were derived from the earlier estimation performed while blindfolded to establish a predictive relevance (Q^2) score of 0.547. The value for the specific dependent (criterion) variable was acquired through a structural path model re-estimation after the predictor variable was removed (Hair Jr et al., 2017). Table 29 displays the q^2 effect sizes of the calculated structural path model.

Table 29 - Results of q^2 Effect Sizes for Dependent (Criteria) Variables – Chapter 4

Results of q^2 Effect Sizes for Dependent (Criteria) Variables					
Independent (Predictor) Variable	**Dependent (Criterion) Variable**	**Q^2 included**	**Q^2 excluded**	**q^2 effect size**	**Interpretation**
Perceived Usefulness	Individual Blockchain Usage Behaviour	0.547	0.525	0.049	Small effect
Motivational Factors		0.547	0.547	0.000	No effect
Design and Implementation		0.547	0.137	0.905	Large effect
Perceived Ease of Use		0.547	0.551	-0.009	No effect

Results from Table 29 indicate that the association between Perceived Usefulness and Individual Blockchain Usage Behaviour has a small effect (0.049). Additionally, the correlation between Individual Blockchain Usage Behaviour and Motivational Factors (0.000) and turnover Perceived Ease of Use (-0.009) may be categorized as having no significant effect, respectively, based on the q^2 sizes observed. On the other hand, Design and Implementation exhibited a significantly large effect on Individual Blockchain Usage Behaviour (0.905).

The independent variables Perceived Usefulness, Motivational factors, Design and Implementation and Perceived Ease of Use were analysed. Results indicate that Design and Implementation is the only factor supported, having a positive influence on individual blockchain usage behaviour at the organisational-level. The results highlight user attitudes of managers at the organisational-level who have a decision making and oversight role to play. The study's results are discussed in detail next. The conclusions addressed in this chapter will be elaborated on based on the study's theoretical foundations and literature review.

CHAPTER 5. DISCUSSION OF THE FINDINGS

5.1 Introduction

The next section of this chapter reflects on the study's presented hypotheses as well as the influences of several independent factors on the dependent variable Individual Blockchain Usage at the Organisational-Level. Selected adoption and prediction characteristics were hypothesized to influence blockchain usage behaviour at the organizational-level, drawing on prior research in blockchain, technology adoption models, and organisational digital transformation. The findings from the preceding chapter are discussed in this chapter, with explanations of the observed outcomes based on both the theoretical foundations and overall context of the current investigation. Finally, a more economic forecasting model of organizational-level blockchain usage behaviour is proposed.

5.2 The Relationship between Perceived Usefulness and Individual Blockchain Usage Behaviour at the Organisational-Level

Hypothesis 1 (H1) was rejected. It was noted that Perceived Usefulness was identified as one of the most important factors in determining blockchain usage behaviour (Almekhlafi & Al-Shaibany, 2021). The study found Perceived Usefulness to be significant, which agrees with most of the literature. However, contrary to the literature, the study found Perceived Usefulness to have a negative effect on Blockchain Usage Behaviour. The study highlights the need for a deeper understanding of the specific context of blockchain technology and its potential challenges. A lack of understanding of the technology and not being able to extract benefit from its use has been highlighted as a significant obstacle to Blockchain adoption (China, 2018; Rauchs et al., 2019). Managers should recognize that despite perceiving usefulness, they may still exhibit a reluctance to adopt a complex technology that does not offer them clear organizational benefits. Previous studies have confirmed that the user interface positively impacts technology adoption (Liu et al., 2010). Blockchain being an underlying technology can be represented by a user-friendly interface, thereby appearing as useful (Sanka et al., 2021). The tendency to hold on to legacy systems further highlights that although perceived usefulness exists, managers are reluctant to disrupt what is already working (China, 2018). Given that managers are driven to extract organisational benefits such as return on investment for shareholders, it is reasonable that even though Perceived Usefulness may be present, they will not adopt technology that is complex and does not offer organisational benefit. Thus, organizations should focus on providing comprehensive education and training programs to enhance understanding and demonstrate the tangible benefits of blockchain adoption.

5.3 The Relationship between Motivational Factors and Individual Blockchain Usage Behaviour at the Organisational-Level

Hypothesis 2 (H2) was rejected. Motivational Factors was found to be insignificant as a predictor of Blockchain Usage Behaviour at the organisational-level. Drawing from Mohapatra et al. (2015), the extended TAM Motivational Factors were to provide a more holistic adoption model for Blockchain Usage Behaviour. In their research, further measures such as rewards and recognition that were found to be important in organisation digital transformation have been included in prior studies (Armstrong & Lee, 2021). Motivational Factors has been found to be significant in technology adoption with the organisation when considering employees that were the end-users (Mohapatra et al., 2015). Considering the respondent profile being Managers within the South African financial services industry, this study found Motivational Factors to be insignificant. Further studies should re-evaluate the measures used and consider a respondent profile in line with that found within the literature to further test this factor.

5.4 The Relationship between Design and Implementation and Individual Blockchain Usage Behaviour at the Organisational-Level

Hypothesis 3 (H3) was supported. It was found that Design and Implementation was a very significant factor in keeping with the literature (Mohapatra et al., 2015). The literature further highlights the importance of skills and training effectiveness from a digital transformation perspective, hence the inclusion of this variable in the study

(Armstrong & Lee, 2021). Risk management also featured highly as a determinant of Blockchain Usage Behaviour within the literature and collectively accounted for the most variation in individual Blockchain Usage Behaviour at the organisation-level (Almekhlafi & Al-Shaibany, 2021; Folkinshteyn & Lennon, 2016; Gil-Cordero et al., 2020; Prewett et al., 2020). Given the associated complexity of adopting blockchain organisationally due to its cross-functional application, it is reasonable when considering the respondent profile of managers, that Design and Implementation will feature highly as a determinant of individual blockchain usage behaviour at the organisational-level. As blockchain technology is inherently complex and has cross-functional applications, organizations need to prioritize well-designed and effectively implemented systems. This involves considering factors such as user interface design, intuitive functionality, and seamless integration with existing organizational processes. Furthermore, organizations should invest in skills development and training programs to ensure employees possess the necessary competencies to navigate and leverage blockchain technology effectively. By addressing these factors, organizations can enhance their readiness and capacity to adopt blockchain technology successfully.

5.5 The Relationship between Perceived Ease of Use and Individual Blockchain Usage Behaviour at the Organisational-Level

Hypothesis (H4) was rejected. Perceived Ease of Use is highlighted in the literature as being one of the most important factors for blockchain adoption (Folkinshteyn & Lennon, 2016; Gil-Cordero et al., 2020; Jain et al., 2020; Kamble et al., 2019; Saif Almuraqab, 2020). However, this study found Perceived Usefulness to be insignificant. In considering this finding, it is noted that the literature highlighted complexity as a major obstacle for blockchain adoption (Prewett et al., 2020; Sanka et al., 2021). Most of the literature is characteristic of respondents that have been significantly exposed to blockchain and as part of this study, it was taken as an assumption that being employed in the South African financial services industry as a manager provided enough background knowledge and experience with which to evaluate blockchain technology. This could have resulted in Perceived Ease of Use being found to be insignificant, contrary to prior expectation. The assumption should be tested first to establish relevant experience before testing the factor in future studies.

5.6 Conclusion

Considering the research questions from Chapter 1 and the stated hypothesis from Chapter 2, this chapter reviewed the research findings of the study considering the existing literature. Discussions of the study's proposed hypotheses' findings and variations in results across contexts were held. The hypotheses that served as the basis for the study's model were assessed. While some of the findings were consonant with those of the existing literature, the study highlighted significant differences in the attitudes of individual user blockchain adoption and usage behaviours at the organisational-level. Perceived Usefulness as an example does not positively contribute to blockchain usage adoption at the organisational-level since managers are motivated by other organisational drivers such as profitability. These key findings highlight the complexities and challenges associated with blockchain adoption in the South African financial services industry context. Managers should carefully consider the specific context or user environment, prioritize education and training, focus on well-designed implementations, and assess the unique factors influencing adoption within their organizations. By addressing these findings, they can enhance their decision-making processes and effectively harness the potential of blockchain technologies. The key research findings of the study are summarized in Chapter 6, along with reflections on their implications for research and management practice. Furthermore, the study's limitations, suggestions for additional research, and the report's conclusion, will be discussed.

CHAPTER 6. CONCLUSIONS & RECOMMENDATIONS

6.1 Introduction

In the preceding chapters, the South African Financial Services Industry was discussed in relation to the adoption of blockchain. The adoption of technology by individuals and organizations, as well as the blockchain literature, was discussed. A research model was created, and theoretical frameworks were outlined. Data collection and analysis were done while the research methodologies were discussed. The conclusions of the study were then interpreted. The study is summarised in this chapter. Stakeholders' implications for the study's findings are described. The report is then concluded after the study's limitations and opportunities for future research are highlighted.

6.2 Summary of the Study

The review of the literature on blockchain adoption revealed the need to measure individual user adoption at the organizational level and not at the end-user computing level because blockchain is an underlying technology that users do not necessarily directly interact with. It was further discovered that the TAM and UTUAT were the most widely used models, focusing on individual user adoption rather than individuals at the organizational level. This study's foundation was the lack of organizational adoption of blockchain in the existing body of research.

This study identified the adoption factors that have an impact on individual blockchain usage behaviour at the organizational-level. A review of the literature on blockchain adoption, enterprise technology adoption, and organizational digital maturity, resulted in the identification of thirty measures. The sixteen indicators they represented comprised thirty measures then collapsed into four key constructs, namely Perceived Usefulness, Motivational Factors, Design and Implementation, and Perceived Ease of Use, respectively.

Testing for validity and reliability was done after the data had been screened. Descriptive statistics were used to answer the study's research questions, and regression and PLS modelling were used to test the hypotheses. At the organizational level, factors from two of the four structures used in this study stood out as direct influencers of Individual Blockchain Usage Behaviour. Perceived Usefulness and Design and Implementation directly influence Individual Blockchain Usage Behaviour at the Organisational Level.

6.3 Implications for stakeholders

This study's implications for practice and academia are discussed in this section.

6.3.1 *Practical Contribution*

The study highlighted key aspects of blockchain usage behaviour of managers in the financial services industry,

Although managers find blockchain useful because organizations prioritize faster delivery and quicker benefit realization, its adoption may decline. Due to the perceived complexity of blockchain technology, which suggests a longer and more challenging implementation, managers must consider delivery methodologies that can address the immediate needs of the organization by allowing for incremental, smaller Minimum Viable Products (MVPs) through demonstration of concepts that increase the value over time. This necessitates a multifaceted strategy where traditional operations may be implemented while smaller teams rapidly deploy blockchain MVPs to reimagine the future. Stand-alone sand-box IT environments should be implemented to facilitate the optimisation of business processes in its entirety, through design thinking and process improvement methodologies. This diminishes the desire to hold on to legacy systems thereby allowing teams to explore the full functionality of blockchain as a solution.

Leaders within the financial services industry, that by its nature is complex since it is high regulated, require a stronger focus on the design and implementation concerning the deployment of blockchain technology, since this will increase adoption. Implementation of a complex technology in an already complicated environment characteristic of many rules, requires the oversight of risk management principles embedded within the project delivery methodology. Managers should ensure cross-functional project teams to design and deliver solutions. The establishment of a centre of excellence for blockchain responsible for the formulation of a community of practice that drives best practice from a digital transformation and change management perspective will place the organisation in better stead to drive blockchain adoption. Managers could consult industry experts to drive training effectiveness and knowledge transfer that has a direct impact on blockchain adoption.

6.3.2 *Academic Contribution*

Although there has been a significant amount of research on blockchain adoption, this study fills a gap in the literature by examining organizational-level individual blockchain usage behaviour. The popular use of the TAM and UTUAT which further exposed a gap in the research, was highlighted by the researcher’s investigation of blockchain technology adoption in the organization. These models do not take individual user adoption at an organisational level into account. Other organizational factors have an impact on individuals at the organizational level who make decisions but are not necessarily computing end users.

This study contributed by expanding the TAM to include elements from organizational digital transformation and enterprise technology adoption. The enhanced model's testing revealed that the design and implementation directly affected organizational behaviour. The study also shows that people's perceptions of usefulness can have a negative impact on organizations' adoption of blockchain technology because they first take organizational priorities and technological complexity into account when deciding whether to adopt the technology at the organizational-level.

6.3.3 *Recommendations for Future Research*

This study provides new directions for future studies on the organisational adoption of blockchain technologies.

First, a comprehension of the organization's digital maturity and how it affects the adoption of blockchain within the organization. Replicating this study with a stronger emphasis on the fundamental indicators of organizational digital maturity is possible.

When combined with blockchain technology, these specific factors will account for more variation in individual blockchain usage behaviour at the organizational-level, offering insightful information that is focused on organizational factors.

Second, this paper emphasized design and implementation as the key factors influencing organizational adoption of blockchain. Future research that examines the effects of various delivery and improvement methodologies, such as design thinking, lean start-up, agile, lean six sigma, and the waterfall model, among others, will be extremely valuable.

Thirdly, training effectiveness in terms of design and implementation was significant, and the literature further emphasized the importance of technical (developer) skills for blockchain adoption. However, determining whether blockchain is applicable to the organization is crucial and depends on analysts or consultants. Future studies should investigate the effects of non-technical skills (such as those needed by analysts, change consultants, and project managers, among others) on the adoption of blockchain.

6.4 Conclusion

There has been significant research on individual usage blockchain behaviour at the user-level globally. However, studies into individual blockchain usage behaviour at the organisational-level and within the South African financial services industry have been limited. Given the potential of blockchain to disrupt the financial services industry and the widespread benefits that can be derived, it is important for managers to gain deeper insight into the adoption of the technology. This study examined the existing body of literature on technology adoption, blockchain technology, and blockchain usage behaviour. The findings of the research study have improved our understanding of individual blockchain usage behaviour at the organisational-level and how it is influenced by Perceived Usefulness, Motivational Factors, Design and Implementation, and Perceived Ease of Use. These findings are important for the successful implementation and adoption of blockchain technology within the South African Financial Services Industry.

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Appendix A – Participant Information Sheet

Dear Participant,

My name is Ashley Paul, and I am currently conducting research in fulfilment of the Master of Management in Digital Business at the Wits Business School (WBS), University of the Witwatersrand, Johannesburg, South Africa.

The topic of my research is: Determinants of organisational blockchain usage behaviour within the South African financial services industry.

By agreeing to participate, you agree that the aforementioned research may use the information you provide for analysis.

This is an anonymous survey, and your identity will not be known to the researcher.

If you have need of any clarification, please contact:

Ashley Paul – Researcher (692930@students.wits.ac.za; Cell: 0845372111)

Prof. Mzyece Mjumo – Supervisor (mjumo.mzyece@wits.ac.za; Tel: 011 7173649)

Dr. Maradona Gatara – Supervisor (Maradona.gatara@wits.ac.za)

Your participation is highly appreciated.

Ashley Paul (692930)

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Appendix B - Instrument

	Demographic Questions	
1	What is your current level in the organisation?	
2	What is your age?	
3	What is your Gender?	
4	What is your highest level of education?	
5	How many years of relevant experience do you have?	

No	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Y	**Organisational Usage Behaviour**	**1**	**2**	**3**	**4**	**5**
Y1	My organisation is focused on blockchain as a strategic priority.					
Y2	My organisation has successfully implemented blockchain use cases.					
Y3	My organisation plans to implement blockchain use cases within the next 12 months.					
X	**Factor - Statements**					
PU1	***Streamlining, standardisation of processes, and practices***					
1	Continuous process improvement methodologies are actively practiced leading to valuable automation opportunity.					
2	In the pursuit of digitalization, my organisation uses latest technologies on its business processes leading to better customer value proposition.					
3	Process automation has resulted in improved speed, transparency, and flexibility in delivering to customer value.					
PU2	***Benefits of the process***					
4	My organisation has realised tangible benefits through cost reduction and increased revenue by employing exponential technologies.					
5	Business Units better serve customers through data insights generated from digitalization which leads to increased revenue and reduced cost.					
PU3	***Digital Product Innovation***					
6	My organisation benefits through more secure asset trading					
7	We leverage technology to build customer ecosystems that provide innovative product/service offerings for our clients.					
8	Digital product innovation gives my organisation the competitive advantage in the market.					
PU4	***New Value Streams and Business Models***					
9	Technology has given us the advantage to form new value streams and business models.					
10	We find diversification opportunities as a business using exponential technologies.					
11	Our products and services are superior to competitors due to increased adoption of new technologies					
MI1	***Rewards and recognition***					
12	My organisation promotes innovative implementation of technology through incentives and recognition.					
MI2	***Willingness to use the new system***					
13	Senior leaders are thought leaders and evangelise the use of exponential technology.					
MI3	***User satisfaction***					
14	My organisation shares information to create awareness of technologies and the possible application within the business.					
15	Staff are encouraged to share their insight and experiences pre and post implementation.					

DI1	***Stakeholder management in the decision process***					
16	Design teams, in my organisation, comprise cross functional members, representing key stakeholders such as customer, product, marketing, IT, risk and compliance, finance, etc.					
DI2	***Effective review process by the senior management***					
17	Appropriate programme and project governance is applied within my organisation for senior management awareness and decisions.					
DI3	***Training effectiveness and skills imparted***					
18	We have skilled people that have been trained to execute on projects involving blockchain.					
19	We employ contractors and have effective knowledge transfer process to build internal blockchain skills.					
DI4	*Risk Management*					
20	Customer privacy and confidentiality is enhanced due to digitisation					
21	The adoption of technology has improved regulatory audit, compliance, and governance.					
DI5	***Innovation and investment***					
22	My organisation has a horizon view on investment and is adequately invested in blockchain.					
23	We have a formal innovation programme where experimentation and rapid prototyping is encouraged within my organisation.					
DI6	***Digital ethics***					
24	My organisation employs digital ethics principals such as customer data privacy, on all designs.					
PE1	***Complexity of the application - blockchain specific***					
25	Blockchain technology creates technical issues that are difficult to navigate.					
26	Scaling of blockchain POC (Proof of Concept) is difficult and presents technical challenges that are difficult to resolve.					
PE2	***System working as per the expectations***					
27	Blockchain **does not** have many applications or use cases within my organisation.					
28	Blockchain creates unintended consequences from a technical and business perspective.					
PE3	***Integration of system***					
29	There is a reluctance in my organisation to replace legacy systems with blockchain.					
30	Blockchain deployments creates technical complexity when integrating into legacy systems within my organisation.					

Appendix C – Ethical Clearance

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg

Wits Business School Ethics Committee
Constituted under the University Human Research Ethics Committee (Non-Medical)

Ethics Clearance Certificate

Ethics protocol number: WBS/DB692930/265

This certificate is only valid with a legitimate ethics protocol number and signed by the Researcher (below)

Project title	Determinants of organisational blockchain usage behaviour within the South African financial services industry
Investigator / Researcher	Mr Ashley James Paul
Nature of Project	MM (Digital Business)
Decision of the Committee	Approved, provided stakeholders and participants are guaranteed anonymity and confidentiality.
Issue Date of Certificate	2022-02-16
Expiry date	Date of submission of the project report
Chairperson	Prof Anthony Stacey ☎ +27 11 717 3587 +27 82 880 4531 anthony.stacey@wits.ac.za

Declaration by Researcher

One copy must be signed by the Researcher and returned to the Chairperson of the Wits Business School Ethics Committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I undertake to resubmit the protocol to the Committee.

Signature

16/02/2022
Date: