TOWARDS A FRAMEWORK FOR IMPROVING UNSTRUCTURED SUPPLEMENTARY DATA SERVICE (USSD) TECHNOLOGY ADOPTION FOR DIGITAL FINANCIAL SERVICES

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University of the Western Cape

Supervisor: Professor Osden Jokonya

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PLAGIARISM DECLARATION

Hereby I, [OWOEYE Oluwaseun Akinbamidele], declare that the thesis **TOWARDS A FRAMEWORK FOR IMPROVING UNSTRUCTURED SUPPLEMENTARY DATA SERVICE (USSD) TECHNOLOGY ADOPTION FOR DIGITAL FINANCIAL SERVICES**
is my own original work. I thus affirm that the content presented in this document is entirely my own original work. Furthermore, I confirm that all sources used in this work have been appropriately cited and acknowledged and that this document has not been previously submitted, either in its whole or in part, for the purpose of obtaining an academic qualification at any other

Full name: Owoeye Oluwaseun Akinbamidele Date: 7th November 2023

Signature ______________

Approved by

Professor Osden Jokonya	**NA**
Main Supervisor	Co-Supervisor
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ABSTRACT

Mobile technology evolution and innovations ushered in various low-cost technologies, such as unstructured supplementary service data (USSD) technology, to accelerate digital financial inclusion and affordable access to digital financial services among developing countries. Due to its (USSD technology) ubiquity and affordability, the Central Bank of Nigeria (CBN) described USSD technology as a major driver of Nigeria's payments system vision strategy implementation. Similarly, the proliferation of mobile phones with an unprecedented increase in licensed USSD financial technology services providers in Nigeria has increased USSD technology's pervasiveness as consumers' preferred digital channel to perform digital financial services. Despite continuous investments in USSD technology roll-out by various financial service institutions to accelerate digital financial inclusion and the over ninety-five per cent digital financial inclusion rate targeted by the CBN by 2025(from the initial 2023 target year set by the CBN), stakeholders and economic actors within the Nigerian banking industry suggest slow adoption of this low-cost technology might impact achieving the target set by the CBN. Following CBN-led stakeholder engagements, the CBN signed a memorandum of understanding(MoU) with the Nigerian Communications Commission (NCC) to deepen mobile network operators' (MNOs) role in the DFS ecosystem and, consequently, to improve USSD technology roll-out. The CBN released a regulatory framework on USSD technology in 2018 to enable players' active participation and deepen USSD technology adoption and usage.

With the growing need for USSD technology in Nigeria, there is a dearth of research linking consumer's behavioural intentions and motivating factors to adopt USSD technology based on its features and capabilities to perform DFS. To address this gap and to also contribute to the IS body of knowledge, the study reviewed existing literature on technology innovation adoption theories and integrated constructs of the Technology Adoption Model (TAM), Stimulus-Organism-Theory (S-O-R), and Information System (IS) Theory to develop a USSD technology adoption framework for the research. The study used technical design and user experience as additional constructs to derive the new USSD technology adoption framework with three factors, which include stimulus factors (features and capabilities of the USSD technology), organism factors (motivating factors for using USSD technology) and response factors (benefits and satisfaction derived from the use of USSD technology). Quantitative and qualitative data were collected, analysed, and triangulated using sequential explanatory mixed methods. The triangulated results identified four themes that significantly contribute to USSD technology adoption decisions by consumers to perform DFS. These are trust, security risk, system quality, and cost. Nine recommendations were made for joint implementation by the CBN and NCC towards improving USSD technology adoption for DFS in Nigeria. The study also suggests future research using a different philosophical approach and extending constructs of the developed USSD technology adoption framework for this study.

KEYWORDS

USSD Technology Adoption Framework, Mobile Payment, Unstructured Supplementary Service Data (USSD) Technology, Technology Innovation, Mobile Technology Innovation, Digital Financial Services, Digital Financial Inclusion, Stimulus Organism Respond (S-O-R) Framework, Explanatory Sequential Mixed Methods, Mobile Banking Services, Fourth industrial revolution (4IR), Epistemology, Pragmatism, Information systems.

DECLARATION

I thus affirm and declare that the thesis has been authored exclusively by the undersigned and has not been previously submitted, either in its whole or in part, to obtain any other academic qualification. Unless otherwise indicated by citation or acknowledgement, I solely authored the work and material given.

Owoeye Oluwaseun Akinbamidele

Student Number: 3879828

DEDICATION

The accomplishment of this thesis is attributed to the support and contributions of my family, friends, and co-workers.

ACKNOWLEDGMENT

I must start with an old proverb: that time goes by quickly. That's not just a line; it's how I feel after all the years of working on my PhD, accompanied by the changing world after the shock of COVID-19.

Firstly, I sincerely appreciate my supervisor, Professor Osden Jokonya, for his invaluable assistance, advice, and patience. Furthermore, you have always pushed me to work harder and more consistently to develop myself and go beyond my comfort zone. I couldn't get your words about standing as a creature with societal obligation out of my head. The spirits you teach me will assist me for the rest of my life. You persistently ensured my research layout and content were aligned with the intended study outcome and focused on contributing to the information system (IS) body of knowledge. You have always motivated and encouraged my research activities, which gave me so much confidence when I doubted myself, especially during the COVID-19 pandemic. I am indeed grateful.

I thank my colleagues at Nigeria Interbank Settlement System Plc for their valuable contributions to the research. Their stimulating talks, various viewpoints, and particular insights have greatly enriched the study. I would like to express my gratitude to Team Qualiquant Services for their valuable contributions and assistance in data collection and statistical analysis, as their efforts have significantly enriched the completion of this project.

I would like to express my profound gratitude to my family during my study. My family has always supported me throughout my academic journey, whether during moments of optimism and enthusiasm for my studies or through adversity and challenges. Your affection for me has significantly shaped my identity and fostered a sense of emotional stability.

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LIST OF ACRONYMS

Abbreviations	Description
1G	First Generation Mobile
2G	Second Generation Mobile
3G	Third Generation Mobile
3GPP	Third Generation Partnership
4G	Fourth Generation Mobile
5G	Fifth Generation Mobile
AC	Authentication Centre
AML	Anti Money Laundering
API	Application Programming Internet
ATM	Automated Teller Machine
BLE	Bluetooth Low Energy
BOP	Bottom Of The Pyramid
CICO	Cash In Cash Out
DFS	Digital Financial Services
CICO	Cash In Cash Out
DFS	Digital Financial Services
EDGE	Enhanced Data For Global Evolution
EMV	Europay, Mastercard, and Visa
GPRS	General Packet Radio Service
GSM	Global System For Mobile Communication
GSMA	Global System For Mobile Communication Association
MNO	Mobile Network Operator
MO	Mobile Originating
MO-SMS	Mobile Originating Sms
MVNO	Mobile Virtual Network Operator
NFC	Near Field Communication
OTA	Over The Air
OTP	One Time Password
OTT	Over The Top
P2A	Person To Account
P2M	Person To Merchant

P2P	Person To Person
PIN	Personal Identification Number
POS	Point Of Sale
QR	Quick Response
RIVR	Remote Interactive Voice Response
SIM	Subscriber Identity Module
SMS	Short Message Service
SOV	Store Of Value
STK	Subscriber Identity Module Toolkit
UI	User Interface
UMTS	Universal Mobile Telecommunication Service
USSD	Unstructured Supplementary Service Data
UX	User Experience
VAS	Value Added Services
VLR	Visitor Location Register
VoLTE	Voice Over Lte
WAP	Wireless Application Protocol

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CHAPTER 1- DIAGRAMMATIC OVERVIEW

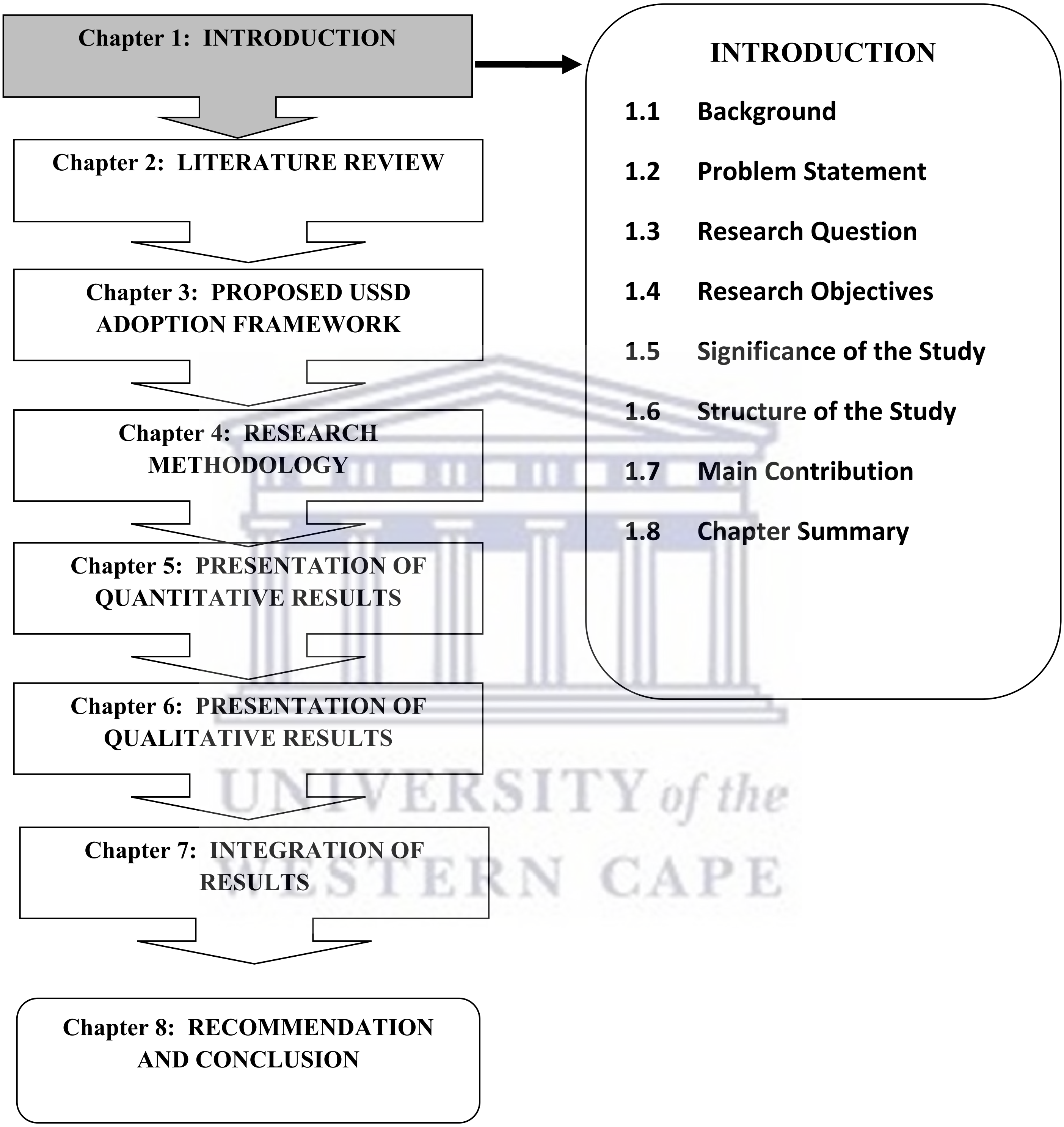

Figure 1.0: Diagrammatic Overview of Introduction

CHAPTER 1 - INTRODUCTION

1.1 Background

From the beginning of the twentieth century, society has undergone a significant digital transformation, culminating in a maturity level propelled by mobile technology advancements. This technology offers individuals novel and stimulating opportunities for cooperation, digitalization of enterprises, and establishing a human-centric global economy (Dougherty, 2017). Similarly, the ongoing advancements in mobile technology innovation have been found to indicate the increasing significance of digital technologies as a prominent aspect of contemporary societal progress and digital financial inclusion initiatives, which cannot be disregarded (Dluhopolskyi et al., 2023). Based on a report released in 2021 by the Global System for Mobile Communications Association (GSMA), a non-profit organization that advocates for the interests of more than 800 mobile carriers globally, mobile technology innovation continues to play a vital role in the pursuit of a digital economy and digital financial inclusion agenda across many developing nations (GSMA, 2022a).

According to Austin-Oluwo et al. (2023), the ubiquity of mobile phones as a low-cost mobile technology to access business services and essential societal needs has increased the proliferation of mobile phones and internet usage since the 19th century. Following the COVID-19 outbreak, scholars (Lyons & Kass-Hanna, 2022; Nepal & Nepal, 2023; Peterson Kitakogelu Ozili, 2022) opined that mobile technology innovation played a significant role in augmenting the global level of digital financial inclusion balance. The pandemic made it clear that digital connectivity is a critical determinant of individuals' lifestyles and the functioning of many organizations. Likewise, in a post-pandemic society, the global population heavily relies on high-speed communication-enabled digital services deemed crucial (Idriss & Ajiya, 2022). They propelled mobile-enabled services, which include access to digital financial services by businesses and individuals (GSMA, 2022a).

Furthermore, the significance of an enhanced digital technology connection facilitated by advanced and cost-effective mobile technology cannot be overstated in the context of the global recovery from the pandemic and the subsequent resumption of social and economic activities. According to Dluhopolskyi et al. (2023), the COVID-19 epidemic has undeniably catalysed the rapid integration of digital technology into many aspects of daily life and economic operations. Despite the advantages of mobile-enabled services, the adoption rate of internet-based mobile-enabled services in emerging countries remains relatively low. The likelihood of this situation is contingent upon the substantial expenses associated with cell phones and the level of internet accessibility (Mallik, Tran, & Twagirumukiza, 2020a). The resultant effect of this phenomenon is a disconnected population, and more are likely to be excluded from the digital economy due to the unaffordability and accessibility of the Internet and smartphone-enabled services (Perlman & Wechsler, 2019a).

In the discussion of affordability, reachability and accessibility of internet services using mobile technology, Dluhopolskyi et al. (2023) also corroborated the views of Perlman & Wechsler (2019a) that mobile technology has expanded global connection and access to various services since the launch of mobile technologies in late 19th century, and they are essential to increase the digital financial inclusion rate of any country. Based on a study by GSMA, the number of mobile internet subscribers in the early twentieth century stands at 4.2 billion (GSMA, 2022a). The study further reveals a significant disparity in use, with over 3.2 billion individuals, accounting for approximately forty-one per cent of the global population, being excluded (GSMA, 2022a). The report also highlights high internet cost, safety, and accessibility to the internet as significant causes (GSMA, 2022b). In the views of previous scholars (Hanouch & Chen, 2015; Idriss & Ajiya, 2022; Muk & Chung, 2015), despite the widespread use of mobile technology, there has been a decline in the utilisation of smartphones for accessing internet-based services.

This trend aligns with the argument made by GSMA (Mogaji, Wayne, & Gbenga, 2020). When considering the adoption rate globally, it is essential to acknowledge that this adoption is not uniformly distributed (Mallik, Tran, & Twagirumukiza, 2020b). The region often referred to as Sub-Saharan Africa encompasses those nations situated geographically south of the Sahara desert. As of 2021, the population of Sub-Saharan Africa (SSA) was estimated at 1.18 billion people (GSMA, 2022b). With Sub-Saharan Africa (SSA) contributing about forty per cent of the world's population, the GSMA (2022a) report on global mobile technology penetration also noted that the area of Sub-Saharan Africa (SSA) has the most limited adoption and use of mobile internet compared to other regions across the world. This indicates that most of the global population lacks access to mobile broadband networks (Mallik et al., 2020b).

Nevertheless, it is essential to acknowledge the progress made in mobile technology innovations over the years, which has played a significant role in driving the growth of a digital economy and enabling greater access to digital financial services for all individuals (Dluhopolskyi et al., 2023). Klaus Schwab, the person responsible for establishing the World Economic Forum (WEF), mentioned that mobile technology innovation would be necessary for the fourth industrial revolution (4IR)(GSMA, 2022b; Xu, David, & Kim, 2018). The term "fourth industrial revolution" describes a society where individuals use related technologies to empower and manage their lives (Xu et al., 2018). Scholars with mobile technology coverage also support the views of the WEF chairman that intelligent mobile technology will catalyse 4IR (GSMA, 2022b; Xu et al., 2018) and ultimately transform the digital financial services landscape (Kharel, 2022; Perlman & Wechsler, 2019a).

On the contrary, as mobile technology innovations continue to change and impact various sectors of the economy, there has been considerable slowness in its adoption to perform digital financial services in developing economies (Perlman & Wechsler, 2019a). This has been attributed to low internet penetration and high smartphone ownership costs (Esmaeili, Haghgoo, Davidaviciene, & Meidute-Kavaliauskiene, 2021; Shaikh, Alamoudi, Alharthi, & Glavee-Geo, 2023), turning these economies into largely cash-based, digitally excluded countries with huge populations that lack access to financial services (Khando & Islam, 2023). Perlman & Wechsler (2019a) suggest that the use of mobile money has become prevalent in the Sub-Saharan Africa (SSA) region powered mostly by USSD technology, and this has drawn the attention of practitioners and academic researchers with a focus on mobile technology innovation in the last two decades (Mogaji et al., 2020).

Mobile money in Sub-Saharan African countries contributes seventy per cent of the total 2021 global transactions (Perlman & Wechsler, 2019a). This is driven by the widespread adoption of USSD-based services offered by banks, mobile money operators, and digital financial services providers (GSMA, 2022b; Mogaji et al., 2020). While other communication services are available for mobile payments, it is believed that USSD is responsible for over 80% of mobile money transactions in Sub-Saharan Africa (SSA) (GSMA, 2022a). The enduring significance, widespread presence, and significance of USSD technology in developing economies have also garnered the interest of prominent internet enterprises such as Facebook, Twitter, and Google (Wohllebe, Dirrler, & Podruzsik, 2020). These firms have collaborated with local mobile carriers to provide access to their internet-based services for customers in developing markets, even without internet-enabled mobile devices, all at minimal cost (Idriss & Ajiya, 2022).

With half the world's mobile money providers operating in SSA, these countries have also intensified efforts to adopt the mobile technology revolution to drive digital financial services. As mentioned in Mogaji et al. (2020), Nigeria, Kenya, and South Africa are the top three leading African countries, leveraging mobile technology innovations, including USSD, to provide various digital financial products and services. With the growing influence of mobile technology on today’s society, the phenomenal impact of mobile technology innovations has also been recognised in Nigeria to enable digital financial services inclusion (Iwedi, 2023). According to the Central Bank of Nigeria (CBN, 2019), the adoption of mobile technology innovations will accelerate digital financial inclusion, given that the issue of digital exclusion is increasingly becoming a significant concern across many markets.

Similarly, Iwedi (2023) cited digital banking platforms and mobile-enabled channels as the preferable access channels for various payment solutions within the Nigerian banking industry.

However, while there is considerable mobile-based technology adoption growth for DFS in Kenya and South Africa relative to their population, Nigeria is relatively behind in the adoption rate of the two countries close to Nigeria's population. It is essential to acknowledge that limited access to digital solutions may impede social mobility and create exclusions for groups who do not possess the necessary knowledge or equipment to engage with the digital financial services ecosystem (Dluhopolskyi et al., 2023). To improve access to digitally enabled financial services that are effective and efficient in Nigeria, banks and mobile network operators explored the use of low-cost mobile technology, such as the USSD technology, to help mitigate the risk of a large digitally excluded population within the financial services sector (Mogaji et al., 2020). The Unstructured Supplementary Service Data (USSD) technology is a globally implemented system used in mobile (GSM) communication technology and operated primarily by mobile network operators (MNOs).

In addition, USSD technology facilitates the transmission of messages between a mobile phone and application software inside the same network (Mallik et al., 2020a). Perlman & Wechsler (2019) describe USSD technology as one of the technological innovations creating a new dimension of threat to established business models. It is novel, economical, user-friendly, pervasive, and universally acceptable for digitally enabled services (Mallik et al., 2020a). Literature has indicated that Nigeria has the largest market share for telecommunications services in Africa (Idriss & Ajiya, 2022; Mogaji et al., 2020; Perlman & Wechsler, 2019a) but with less than sixty-five per cent digital financial inclusion rate (EFInA, 2021). As part of regulatory intervention to improve digital financial inclusion in Nigeria, the Central Bank of Nigeria (CBN) in 2017 implemented a payment system strategy design and entered into a formal agreement, known as a Memorandum of Understanding (MoU), with the Nigerian Communications Commission (NCC) to formally include telecommunication service providers into the mainstream of digital financial services.

Following the joint agreement by the CBN and NCC to foster partnership towards deepening USSD technology services in the digital financial services ecosystem, a regulatory framework on Unstructured Supplementary Service Data (USSD) was released in June 2018 as part of payment system vision initiatives to securely make access to digital financial services affordable and cost-effective among Nigerians by the year 2025. This phenomenon has tremendously led to various studies on improving USSD technology adoption to perform digital financial services (DFS) in Nigeria. Despite continuous investments and regulatory interventions by the two regulators in the mainstream of USSD technology utilisation in Nigeria, USSD technology's low adoption rate is mainly attributed to the use of a multi-disciplinary perspective to understand the effects of the features and capability of USSD technology and what could stimulate human decisions to adopt and use USSD technology (Lai, 2017). Although extensive research has been conducted on adopting mobile money for digital financial services in Nigeria, with the growing need for USSD technology in Nigeria, there is a dearth of research linking consumer's behavioural intentions and motivating factors to adopt USSD technology based on its features and capabilities to perform DFS within the context of the Nigerian banking and digital financial services ecosystem.

To address this gap and to also contribute to the IS body of knowledge, the study reviewed existing literature on technology innovation adoption theories and integrated constructs of the Technology Adoption Model (TAM), Stimulus-Organism-Theory (S-O-R), and Information System (IS) Theory to develop a USSD technology adoption framework for the research. By conducting a comprehensive study that encompasses these elements, a more holistic understanding of the USSD technology adoption decision process can be achieved (Idriss & Ajiya, 2022; Lim, Lakhoua, & Mazzawi, 2016; Perlman & Wechsler, 2019a). In response to this discovery, the study proposed a framework to improve USSD technology adoption for digital financial services in Nigeria and followed a mixed-method research strategy to empirically investigate the constructs of the proposed framework for the study.

1.2 Problem Statement

As of December 2022, Nigeria's population is approximately 220 million, with about sixty per cent adult population and eighty per cent mobile phone penetration. According to Enhancing Financial Innovation and Access (an organisation working on financial services deepening in Nigeria), financial exclusion in Nigeria as of December 2020 stands at thirty-six per cent against a five per cent target by 2025 as indicated in the Central Bank of Nigeria revised National Financial Inclusion Strategy (NFIS 3.0) (EFInA, 2021). This implies that about thirty-six per cent of the population is excluded from the digital financial services ecosystem. To bridge this gap, the CBN swiftly activated a payments system strategy to ensure that not less than ninety-five per cent of Nigerians have access to secure and affordable digital financial services. As indicated by the apex bank, USSD technology is a crucial enabler of these strategic initiatives to improve access to essential financial services and ultimately enhance digital financial inclusion.

Despite these interventions and the prevailing socio-economic challenges in Nigeria, the adoption rate of USSD technology for digital financial services remains relatively low. This has also been indicated in the digital financial inclusion rating by EFInA (2021) and Nigeria's payment system vision 2023 report by the Central Bank of Nigeria. Consequently, this might not enable Nigeria to achieve the projected USSD technology adoption and usage rate to drive digital financial inclusion. From a theoretical standpoint, technology adoption challenges necessitating combining the technology's features and capabilities and the adopter's motivation to use that technology are too complex to be solved with a single approach, as there is no one-size-fits-all solution to problem situations.

Furthermore, IS theories that underpin technology adoption research, such as the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), the Theory of Reasonable Action (TRA), Technology-Organisation-Environment (TOE) Information System Success (IS) Theory and Diffusion of Innovation (DOI) theory all leverage TAM as a foundational theory for technology innovation adoption (Granić, 2023; Lai, 2017; Sadeck, 2022). With the intangibility of benefits derived from features and capabilities of new technologies, Lai (2017) opined that the technology's features and capabilities on the individual's purpose and incentive to utilise the technology is highly important and could lead to technology adoption resistance if not carefully examined using additional research lens outside existing technology adoption theories. In addition, numerous scholars have questioned the applicability of existing technology adoption frameworks, as well as whether choices on the deployment of a widespread technology such as USSD are made in a complex digital financial services ecosystem where the interests of service providers, customers, and regulators are considered (Granić, 2023; Han & Wang, 2021; Lai, 2017; Sadeck, 2022).

According to DeLone & McLean (2002), adoption does not equate to the success of adopting the technology. IS Success theory was introduced to measure the success of adopting a new technology (DeLone & McLean, 2002). Also, Lai (2017) suggests that using a single theory or model in IS research provides an insufficient outcome for handling the decision-making issues of individual users with different perspectives on user experience, features, and capabilities of the technology within a complex financial ecosystem. It requires an interdisciplinary approach to understanding the phenomenon from a multi-disciplinary standpoint and to ensure different perspectives of the researcher and all the participants are adequately represented (Han & Wang, 2021). The following section discusses the research question and the study's objective.

1.3 Research Question

Based on the problem statement, the following research questions will be addressed.

1.3.1 Primary Research Question

- How will Unstructured Supplementary Data Service (USSD) Technology adoption for Digital Financial Services be improved within the Nigerian banking industry?

1.3.2 Secondary Research Questions

The overall research question will be answered based on the following sub-questions:

- What are the current challenges of Unstructured Supplementary Data Service (USSD) technology adoption for digital financial services in Nigeria?
- How can the current challenges in using USSD technology for digital financial services in Nigeria be addressed?
- How will the stimulus factors (features and capabilities of the USSD technology) and organism factors (motivating factors for using USSD technology) on the response (adoption and use of USSD technology) for digital financial services in Nigeria
- What would be a framework to improve the adoption of USSD technology for Digital Financial Services within the Nigerian banking industry?

1.4 Research Objectives

1.4.1 Primary Research Objective

The primary objective of the proposed research is

- To propose a framework to improve Unstructured Supplementary Data Service (USSD) Technology adoption for Digital Financial Services in the Nigerian banking industry

1.4.2 Secondary Research Objectives

The secondary objectives are:

- To investigate the current challenges of Unstructured Supplementary Data Service (USSD) technology adoption for digital financial services in Nigeria
- To investigate how the current challenges in the use of USSD technology for digital financial services in Nigeria can be addressed
- To determine the impact of the stimulus factors (features and capabilities of the USSD technology) and organism factors (motivating factors for using USSD technology) on the response (adoption and use of USSD technology) for digital financial services in Nigeria
- To develop and validate a framework to improve USSD technology adoption for digital financial services in Nigeria and make recommendations based on research findings

1.5 Significance of the Study

Research aims to solve a specific knowledge gap, which refers to a subject or area of inquiry that has not yet been fully explored or answered. This issue may arise from prior research or may be entirely new. The primary objective of doing research is to address and bridge existing gaps in knowledge by generating novel insights and contributing to the current body of knowledge (Miles, 2017). In essence, research aims to provide novel contributions to scientific literature rather than replicating existing knowledge. Also, IS study offers an interdisciplinary approach to understanding a phenomenon from a multi-disciplinary standpoint. Prior academic research focusing on technology innovation, technology diffusion, and technology adoption has successfully used a combination of theories and models to derive research outcomes (Harasim & Klimontowicz, 2013; Shailza & Sarkar, 2019). Some of these include UTAUT, TRA, TPB, and TAM. While TAM provides the fundamental theoretical framework for developing subsequent models, the original TAM has evolved, resulting in TAM2 and TAM3 (Granić, 2023).

Due to complexities emanating from technology adoption, which can be internal or external, and subjectivity around human decisions, TAM 1, TAM2, and TAM3 have been chastised for failing to provide the necessary insight into the direct and indirect impact of constant technological change(Granić, 2023; Hanouch & Chen, 2015; Lai, 2017), such as that seen in the banking industry, which simultaneously creates threats and opportunities without taking into account the impact of the technology's features and capabilities on the customer's purpose and incentive to use the system (Lai, 2017). Scholars opined that the adoption of USSD technology is associated with various complexities and challenges, and it is essential to review these complexities beyond the TAM lens (Granić, 2023; Hanouch & Chen, 2015; Lai, 2017). To progress this philosophical assertion, this study examined existing literature on USSD technology development and criticism of past theories behind technological innovation acceptance.

The study's main contribution is developing and validating a USSD technology adoption framework and how it will influence the decision-making of banking consumers to perform digital financial services in Nigeria. In research, adoption does not equate to the success of adopting the technology. Therefore, IS Success theory was introduced to measure the success of USSD technology adoption (DeLone & McLean, 2002). As a contribution to the body of knowledge, the study comprehensively reviewed existing literature on technology innovation. It proposed a USSD technology adoption framework by integrating constructs of the Technology Adoption Model (TAM), Stimulus-Organism-Theory (S-O-R), and Information System (IS) Theory to investigate adoption factors based on features, capabilities, and usage intentions of USSD technology to perform digital financial services among Nigerians with the addition of USSD technical design and user experience lenses.

The proposed framework is hypothesised and investigated using a mixed-methods research strategy. As a motivator for adoption and use, the research framework replaced perceived ease of use with User Experience in previous TAM research. Trust and System Quality and Design and Security were represented as stimuli for the adoption and use of USSD technology for Digital Financial Services. In the field of Information Systems (IS) research, the process of constructing a novel theoretical research framework is contingent upon comprehending research challenges and objectives, conducting gap analysis, identifying the target market, engaging with pertinent stakeholders, establishing goals, and assimilating knowledge about technology adoption models and theories (Lai, 2017). According to Lai (2017), it has been suggested that possessing such knowledge is crucial to facilitating successful engagement among many stakeholders, such as students, academics, researchers, government entities, and organizations, with both the theoretical and practical dimensions of technology adoption models and theories.

In addition, technology innovation diffusion literature with a focus on global socio-economic development suggests USSD technology, a part of the 4IR, will reshape business models of banks in the wake of fintech capable of disrupting the digital financial service ecosystem with technological advancements, such as artificial intelligence (AI), machine learning, blockchain technology, and the internet of things (IoT), (Xu et al., 2018). GSMA (2022a) also asserts that USSD technology is a driving force in the circle of 4IR technologies. They significantly impact banking institutions' business models in the wake of digital financial service ecosystem disruption by fintechs (Mallik et al., 2020a; Perlman & Wechsler, 2019a; Xu et al., 2018). Due to its novelty, USSD technology complements traditional business models and provides chances for unique service offerings (Lai, 2017). With this development, banks and new entrants into the digital financial service ecosystem have resulted in the use of USSD technology, which is the most prevalent, to provide essential financial services such as lending, person-to-person payment, and airtime top-ups that are cost-effective and efficient (Isiguzo, 2010; Mallik et al., 2020a; Mogaji et al., 2020; Perlman & Wechsler, 2019a).

Similarly, the future-generation banking sector in emerging nations relies on USSD technology to enhance digital financial services while partnering with mobile network providers (Hanouch & Chen, 2015). The claim by GSMA (2022a) with Hanouch & Chen (2015) posits that USSD technology has facilitated the ability of clients in emerging markets to use internet-based services without necessitating the use of internet-enabled mobile devices. This phenomenon has piqued the interest of internet businesses such as Facebook, Twitter, and Google (GSMA, 2022a). Nigerian banks have adopted the USSD technology to meet more customers and ensure financial inclusion. With USSD codes, users can access essential financial services, including interbank payments and transfers, paying bills, checking account balances, blocking or unblocking their ATM cards, updating their bank verification number (BVN), and many more.

Despite massive technological investments in USSD technology by Nigerian banks and telcos to compensate for low internet and smartphone penetration due to affordability, the Central Bank of Nigeria opines that the adoption and usage rate is low compared to the desired target state. This requires exploring adoption and usage determinants from a combined theoretical lens. The following section outlines the research strategy adopted for the study.

1.6 Structure of the Study

Chapter 1: ***Introduction:*** The chapter provides the background on the novelty of USSD technology and its relevance in the global and Nigerian digital financial services ecosystem. The chapter further presents the issue description and rationale for doing the study. The subsequent step emphasises the research inquiries and goals used in formulating the recommended framework for deploying USSD technology. The chapter also discusses the importance of the study, providing a background on the information systems theories used in prior research and their pertinence to the current study. The organization of this chapter is as follows: Section 1.2 introduces the problem statement that the study aims to address. Section 1.3 formulates the primary research question that guides the investigation. Section 1.4 outlines the study objectives, which delineate the specific goals to be achieved. Section 1.5 elucidates the significance of the study, highlighting its importance and potential impact.

Section 1.6 provides an overview of the chapter structure, outlining the organisation and content of subsequent sections. Section 1.7 highlights the study's main contributions, emphasising its novel insights or advancements in the field. Finally, section 1.8 offers a concise summary of the chapter, summarising its key points and findings. Furthermore, the chapter presents a comprehensive overview of the subsequent chapters that will be discussed.

Chapter 2: ***Literature Review:*** The existing body of literature in Information Systems (IS) research has laid the foundation for comprehending USSD as a prominent technology for digital financial services. This literature has also established the theoretical framework that supports the adoption of USSD technology, which serves as the basis for this study. The literature review chapter provides a contextual framework for comprehending the evolutionary process of mobile technology and mobile technology innovations from a global standpoint. The chapter also discusses various USSD technology use cases and their applicability in the digital financial services ecosystem, emphasising

Nigeria's digital financial services ecosystem and USSD technology implementation within the country's banking sector. The chapter further examines the present state of USSD technology implementation in Nigeria for digital financial services.

Relevant theories to the study were also discussed in this chapter. The chapter also identifies the existing knowledge gap in the research field about the suggested framework for adopting USSD technology. This framework aims to facilitate the comprehension of the factors influencing the decision-making process of regulators and digital service providers in adopting USSD technology.

Chapter 3: ***The Proposed Framework:*** The proposed USSD technology adoption framework for the study is described in this chapter. As elucidated in chapter two, the framework has been established and suggested by examining prior scholarly research and pertinent material on using USSD technology. The proposed USSD technology adoption framework framed around TAM theory, S-O-R, and IS theory has its constructs and research hypothesis outlined according to the literature review in chapter two. The chapter further discusses constructs of the framework proposed to improve USSD technology adoption for digital financial services in Nigeria, which include stimulus factors (features and capabilities of the USSD technology), organism factors (motivating factors for using USSD technology), and respond (adoption and use of USSD technology). In addition, this chapter discusses constructs of the USSD technology adoption framework and how the research hypothesis has been laid out to pave the way for data collection as a contribution to the body of knowledge in IS research.

The chapter highlights the importance of the USSD technology adoption framework in individuals' decision-making to perform digital financial services in Nigeria.

Chapter 4: ***Research Methodology:*** Following the research objectives highlighted in Chapter One and the proposed framework for USSD technology adoption as detailed in Chapter Three, this chapter discusses the composition of the data collection instruments constructs of the USSD technology adoption framework, which includes stimulus factors (features and capabilities of the USSD technology), organism factors (motivating factors for using USSD technology) and respond (adoption and use of USSD technology) for digital financial services in Nigeria. More importantly, the chapter systematically describes the mixed-methods research strategy underpinning the USSD technology adoption framework analysis proposed in chapter three. In addition, the chapter described the paradigms, theoretical models, and philosophies adopted to derive the research outcome. It also articulates the rationale for selecting explanatory sequential mixed-methods research methodology concerning its appropriateness in addressing the research question and achieving the objectives, first from a quantitative perspective and followed by a qualitative review of the quantitative results.

The description of the respondents for both qualitative and quantitative data collection methods and analysis is also presented in this chapter. Finally, the chapter elucidates the ethical considerations and the limitations inherent in the study.

Chapter 5: ***Presentation of Quantitative Results:*** The chapter presents the quantitative research results using a standard survey technique for data collection and empirical analysis of these data. The chapter quantitatively analyses responses received from respondents to determine the impact of the stimulus factors (features and capabilities of the USSD technology) and organism factors (motivating factors for using USSD technology) on the response (adoption and use of USSD technology) for digital financial services in Nigeria. This is the first validation of the USSD adoption framework based on data from questionnaires.

Chapter 6: ***Presentation of Qualitative Results*****:** This chapter explains the output of the qualitative analysis using a semi-structured interview questionnaire to elicit information on each of the thematic areas of the study. Results discussed in this chapter help to validate and understand the correlation of the quantitative results with the research objectives.

Chapter 7: ***Integrated Results*****:** Based on the explanatory sequential mixed methods adopted for the research, this chapter presents integrated results by linking both quantitative and qualitative results. The process of linkage called triangulation provides a complementary perspective of the overall research outcome as part of the discussion to address the research question. The chapter further provides the basis to cross-validate research findings by comparing quantitative and qualitative results, boosting their conclusions' overall validity and dependability.

Chapter 8: ***Recommendation and Conclusion:*** Based on the findings of the study on the proposed framework to improve Unstructured Supplementary Data Service (USSD) Technology adoption for Digital Financial Services in the Nigerian banking industry, the chapter elaborates on the relevance of results in answering research questions and how each objective as highlighted in chapter one of the study were achieved. Conclusions drawn from research results were presented, and recommendations were outlined on how USSD technology adoption can be improved to enable the growth of digital financial services in Nigeria. The chapter also discussed how it contributed to the body of knowledge, the limits of the study, and areas for future academic research.

1.7 Main Contribution

The study's main contribution is to develop and validate a framework to improve USSD technology adoption decisions to perform digital financial services in Nigeria. Constructs of the USSD technology adoption framework and empirical results from quantitative and qualitative analysis provide a baseline for future academic research focusing on USSD technology adoption and usage within the Nigerian banking industry. Furthermore, the study's outcome is essential for banks, MNOs, and the two regulators (CBN and NCC) to understand the pain points of bank customers and areas where policy, standards, and technology interventions can be applied. In addition, recommendations of this study would enable relevant stakeholders to execute tactical and strategic interventions in the realisation of improved USSD technology adoption and ultimately achieve a ninety-five per cent financial inclusion target of the Central Bank of Nigeria by 2025. The other contributions of the study include two peer-reviewed publications.

1.8 Chapter Summary

To realise the research objective, it is essential to contextualise the proposed study's justification, methodology, and expectations. Chapter one of this study provided the background on USSD technology evolution and highlighted the challenges of adoption decision-making from consumer and organisation perspectives. Drawing on previous IS research on novel technology adoption, such as the USSD technology, a limitation exists in providing a research lens on how the technology's features and capabilities could impact customers' purpose and incentive to adopt the technology from different stakeholder’s worldviews. From a behavioural decision standpoint, there are limitations on the applicability of existing IS theories, where user experience and understanding of features and capabilities are essential in consumer decisions to use USSD technology for digital financial services. This limitation requires an improved USSD technology adoption framework, which is the goal of this research.

Discussed in this chapter are the research problem, research questions, objectives of the research, and the structure of the study to investigate and validate the proposed USSD technology adoption framework for the study that will assist individuals, banks, and telecommunication companies in understanding the determinants of USSD technology adoption decisions to perform digital financial services. In addition to the abovementioned content, the chapter provided an overview of the research framework and deliberated on the study's importance and impact on the broader research field. The following chapter examines the existing literature on mobile technology evolution, the digital financial services ecosystem, USSD technology in digital financial services, and the theories underpinning the research.

CHAPTER 2- DIAGRAMMATIC OVERVIEW

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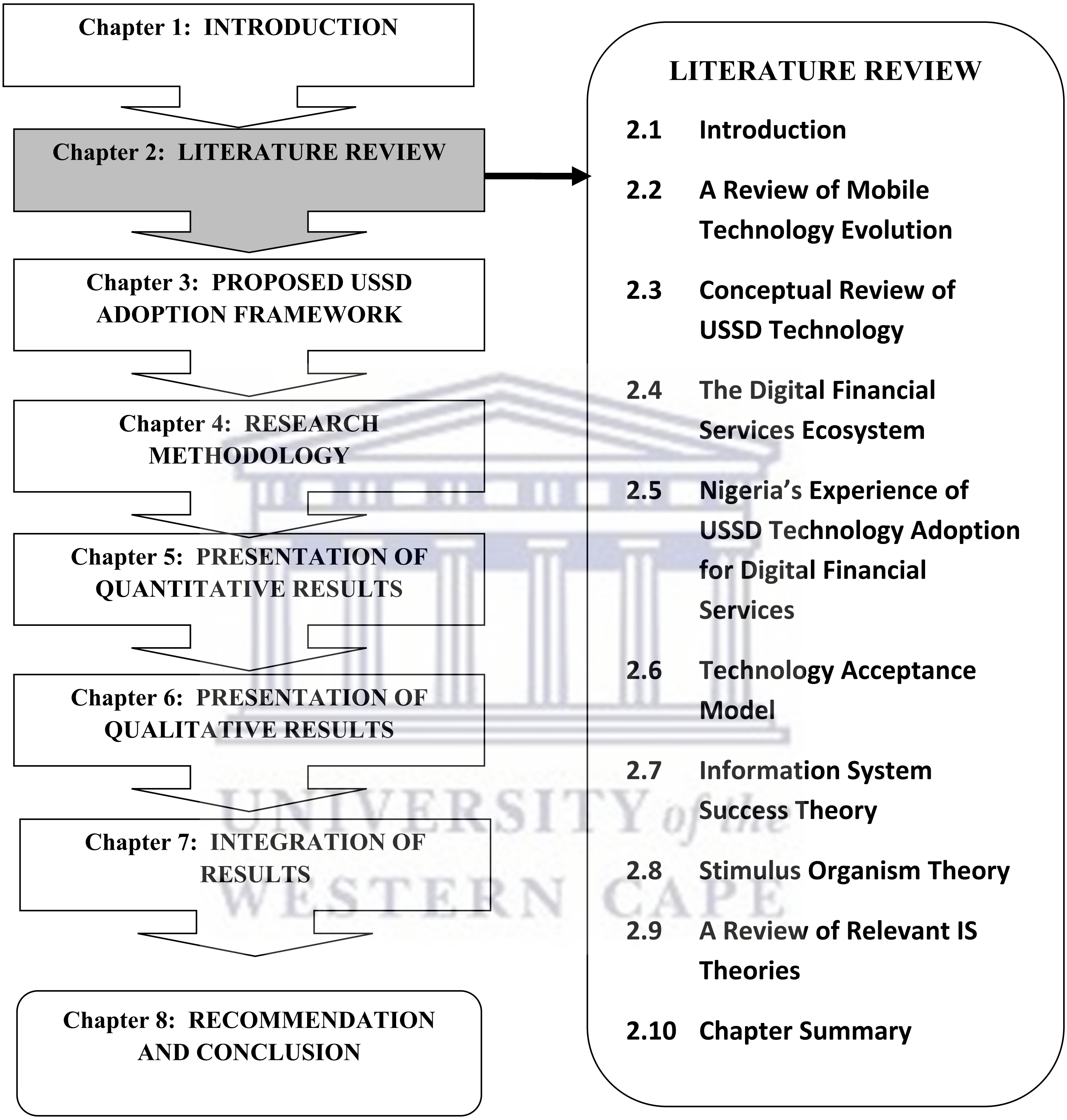


Figure 2.0: Diagrammatic Overview of the Literature Review

CHAPTER 2 – LITERATURE REVIEW

2.1 Introduction

In the previous chapter, we discussed the research background, the problem statement, objectives, the research question, the significance of the research, the contribution of the investigation, and the structure of the study. This chapter reviews current literature on mobile technology evolution, USSD technology overview, and the digital financial services ecosystem. The chapter also reviews various literature on the Digital Financial Services (DFS) ecosystem and different use cases of USSD technology within the Nigeria DFS ecosystem. The World Bank established an objective under its Universal Financial Access initiative in 2014, aiming to provide individuals excluded from the official financial system with the opportunity to get a transaction account by 2020. This account would facilitate the holding of money and the execution of payment transfers.

Regrettably, the worldwide adult population's access to bank accounts or mobile wallets in 2017 was limited to a mere sixty-nine per cent, falling far short of the desired goal of achieving complete digital financial inclusion by 2020 (PwC, 2021). This later evolved as part of the United Nations Vision 2030 objectives. According to Bech & Hancock (2020), financial exclusion is often a component of a broader phenomenon known as social exclusion. This implies that the limited availability of essential financial services and transaction accounts has hindered the ability of those without bank accounts to obtain these services (Priem, 2020). This is primarily due to the associated costs, such as the expenses incurred when accessing bank digital channels and the absence of required due diligence documents (Rysman & Schuh, 2017). The last ten years have witnessed an exciting transition within the Nigeria digital financial services ecosystem through implementing various USSD technology-based products and services offered by banks and telecommunications service providers.

Despite multiple initiatives spearheaded by the Central Bank of Nigeria and other industry stakeholders to improve USSD technology adoption, Nigerians have had a slow adoption rate (EFInA, 2021). Mobile technology innovations are integral to digital financial inclusion (Dluhopolskyi et al., 2023) and complement digital financial service offerings. According to Ngwengeh et al. (2021), it is pivotal in facilitating economic progress by offering streamlined digital financial services. However, given the rise in mobile payment innovations and increasing use of and demand for smartphones to perform digital financial services (BIS, 2021a), USSD technology remains a crucial driver for the digital financial inclusion agenda (Austin-Oluwo. et al., 2023) due to its affordability and cost-effectiveness, when compared to the unaffordability of smartphones and low internet penetration among developing countries like Nigeria (Mallik et al., 2020b).

Despite the growing demand to build an inclusive ecosystem among multiple players, regulators, and stakeholders (Boel, 2019). From a regulatory perspective, the literature suggests that government entities have invested considerably to ensure access to low-cost internet and mobile connectivity is achieved (Ray, Morgan, & Thakur, 2022). This is also an essential part of the United Nations digital inclusion program, as mentioned earlier (Peterson K. Ozili, 2023), focusing on leveraging USSD technology as a low-cost tool to promote inclusivity. However, with increasing and continuous investments and regulatory interventions by the two regulators in the mainstream of USSD technology utilisation in Nigeria, USSD technology's low adoption rate has been attributed to the lack of an appropriate framework from an academic research perspective (Lai, 2017) and to understand further the features and capability of the technology and human behavioural decision factors to adopt USSD technology (Rysman & Schuh, 2017).

According to Shaikh et al. (2023), the current body of research on USSD technology adoption is limited in its exploration of the consumer, technical capabilities, management, policy, and theoretical viewpoints. Han & Wang (2021) suggest that the features and capabilities of USSD technology within a complex financial ecosystem like that of Nigeria must be examined to determine its adoption rate. To corroborate the views of Han & Wang (2021), IS scholars have also questioned the broader applicability of existing technology adoption frameworks with human behavioural intentions, as well as whether choices on the deployment of mobile technology such as USSD technology by service providers are made in the best interests of service providers, customers, or both (Granić, 2023; Han & Wang, 2021; Lai, 2017; Sadeck, 2022). If not carefully examined, Kaur et al. (2020) suggest that this phenomenon leads to resistance to technology adoption.

Furthermore, from a theoretical standpoint, scholars (Granić, 2023; Lai, 2017; Sadeck, 2022) argued that technology adoption challenges necessitating combining the technology's features and capabilities and the adopter's motivation to use that technology are too complex to be solved with a single theory approach. Such a phenomenon requires an additional theoretical research lens to evaluate the impact of the technology's features and capabilities on the customer's motivation to adopt and utilise the technology (Lai, 2017). To pave the way for an understanding of the theories underpinning the proposed USSD technology adoption framework in this study, the literature review chapter also discusses the Stimulus Organism Theory, Technology Acceptance Model (TAM), and Information System Success Theory. Furthermore, the chapter systematically reviews previous literature on USSD technology adoption frameworks from theoretical and practical lenses.

The current chapter is organized in the following manner: Section 2.2 presents a comprehensive examination of the evolutionary progression of mobile technology. In section 2.3, a conceptual analysis of USSD technology is provided. Section 2.4 delves into the digital financial services ecosystem. The adoption of USSD technology for digital financial services in Nigeria is explored in section 2.5. Section 2.6 delves into the Technology Adoption Model, while section 2.7 discusses the Information System Success theory. The Stimulus Organism theory is examined in section 2.8. Relevant Information System theories are discussed in section 2.9, and finally, section 2.10 presents a summary of the chapter.

2.2 A Review of Mobile Technology Evolution

Historically, many items were used to facilitate financial services, including payments for goods and services. The direct sale of goods or services by individuals and businesses was initially achieved through the barter system, the predominant means of exchange in the late 16th century (Aechler & Moser, 2019). According to Carstens (2019), stones, shells, cigarettes, and cash also served as payment. Within those periods, economic exchange was mainly limited to simple bilateral relationships, which also involved one agent producing a good and a consumer paying for it (Boel, 2019). As cash continued to get wider popularity and adoption as monetary value for exchange in the early 18th century (Nakajima, 2017), this induced the increasing role of digitisation in the financial lives of more and more of the world's population due to technological innovations (pwc, 2016). As technological innovation continues to expand in the mobile technology industry, it has become evident that technological innovation is the most pervasive force affecting digital financial service delivery by banking institutions at large, post-Covid-19 pandemic (Feyen, Frost, Gambacorta, Natarajan, & Saal, 2021).

According to Khando & Islam (2023), the COVID-19 pandemic accelerated the digitalisation of payments using financial technology (fintech) and mobile technology innovations. To corroborate this assertion, a major issue discussed by professionals and researchers post-COVID-19 pandemic is the digitalisation of payments in the global economy lockdown, with mobile phones being the main access channel to all digital payment platforms (PwC, 2021). In addition, the Bank for International Settlement (BIS) also alludes to the fact that from mid-2019, the payments industry advanced in an irreversible quantum leap of non-cash payments due to the COVID-19 pandemic, with consumers accessing digital payments mainly through their mobile phones (BIS, 2021b). More customers worldwide paid digitally, (near) instant using mobile phones and contactless cards (Ponce, 2020). This phenomenon has tremendously impacted the usage of various payment innovations across the banking industry (Carstens, 2020).

Similarly, Boel (2019) opined that digital financial services are seeing significant transformation on a global scale, driven mainly by technological advancements. A resultant effect is that the economic landscape would have several notable transformations (Błach & Klimontowicz, 2021). These changes include the diminishing significance of cash in electronic commerce, the widespread acceptance of digital banking platforms, the integration of mobile technologies, and the increasing prevalence of expeditious payment solutions pioneered by fintech enterprises. According to a global cashless payment report by PwC, cashless payments are projected to rise more than eighty per cent by 2030 due to the impact of the COVID-19 pandemic and further adoption of mobile-based payment services (PwC, 2021). According to Feyen et al. (2021), the aforementioned issue has significantly influenced the adoption and ease of use of diverse new payment technologies within the banking sector.

According to Hidayat-Ur-Rehman et al. (2021), mobile technology has undoubtedly greatly enhanced convenience, ubiquity, and usefulness in both personal and global corporate contexts. Having discussed the importance of mobile technology in the global digital payment landscape, the study further provides an understanding of its advent. Since the early 1980s, mobile technology has existed, and it has taken a little over forty years from the creation of wireless cellular technology to get from 1G to 5G (GSMA, 2022a). A lot has changed since then. Cell phones have shrunk in size. The download rate has increased. Many individuals nowadays use their phones to access the internet. Social media posting is still seamless on mobile phones (Prasad & Semwal, 2023). According to the GSMA (2022a), the mobile technology industry has significantly contributed to the global network and providing access to various services.

As of December 2021, the number of individuals subscribing to mobile services reached 5.3 billion, which accounts for around sixty-seven per cent of the worldwide population. In several developing economies, there is a notable prevalence of mobile phone ownership among the adult population. Consequently, this sector's expansion trajectory is expected to be driven by younger generations acquiring personal mobile subscriptions. This trend is driven by their desire to use mobile technology for various purposes, including personal usage, commercial endeavours, and accessing many options (Granić, 2023; Mallik et al., 2020a; Mogaji et al., 2020). According to the projections made by the GSMA, there is anticipated to be a notable increase of four hundred million individuals subscribing to mobile services by 2025 (GSMA, 2022a). Most new subscribers are expected to come from Asia and Sub-Saharan Africa.

Consequently, this surge in subscriptions is projected to elevate the overall mobile users to 5.7 billion (seventy per cent of the global population)(GSMA, 2022a). Ponce (2020) further argued that mobile businesses will play a crucial role in expanding internet access to enhance the means of connecting with billions of people worldwide. Following the views of Ponce (2020) and GSMA (2022), GSMA (2022) reported that in 2021, the worldwide mobile internet user count has reached a staggering 4.2 billion individuals. Ninety per cent of individuals in developed countries were online compared to only nineteen per cent in the world's least developed countries (GSMA, 2022a). Despite Africa's low mobile internet penetration and usage in the global economy (Mallik et al., 2020b), Africa's young population is a potential asset for relatively high economic growth. With this potential, the mobile ecosystem provides more than six per cent of Sub-Saharan Africa's gross domestic product (GDP) and is projected to climb to eight per cent by 2025 (Idriss & Ajiya, 2022).

Since 2021, mobile technology and services have contributed an estimated $4.5 trillion to the worldwide economic value added, accounting for around five per cent of the Gross Domestic Product (GDP) (GSMA, 2022b). Furthermore, the projected growth of this number is expected to exceed $400 billion by the year 2025, reaching a value of about $5 trillion. This growth is attributed to the rising use of mobile services, which has enhanced productivity and efficiency in many nations (GSMA, 2022a). Based on empirical and qualitative evidence, mobile technology impacts global sustainable development goals (SDGs). Notably within the banking and financial services domain, Rafee (2020) opined that mobile technology has enabled branchless banking with time–anywhere services in the digital financial services landscape. The adoption of near-field communication (NFC)-enabled and contactless mobile payment applications, such as mobile wallets and wearable devices, has led to the substitution of automated teller machines (ATMs), point-of-sale (POS) terminals, and traditional payment cards (Iman, 2020; PwC, 2021).

Furthermore, chatbots and robo-advisors have also created an intelligent mobile-enabled banking and payment culture in many developed countries. Undoubtedly, the advent of mobile technology has substantially influenced the socioeconomic landscape, effecting notable changes in the circumstances of several marginalized communities worldwide who lack access to financial services (Shaikh et al., 2023). To corroborate the views of Iman (2020), industry professional from the GSMA also asserts that mobile technology has evolved in attributes and capabilities since its launch in the late 19th century, and as the world emerges from the pandemic and social and economic activities begin to recover, mobile connectivity will continue to play a vital role in how people live, transact digitally and how businesses operate (GSMA, 2022a). According to Mallik et al. (2020a), societies will see an increased integration of digital economies driven by mobile technologies and high-performance networks in a post-pandemic era.

In this context, unconnected populations will be at greater risk of exclusion from many life-enhancing services online. To bridge this gap, telecommunication operators' investments in network infrastructure over the last decade have helped to shrink the coverage gap for mobile broadband networks, which is evident in the mobile money ecosystem in SSA (Neza, Joseph, & Joseph, 2022). Despite the continuous investment, innovative solutions implementation, and partnerships to extend connectivity to still underserved and far-flung communities, the adoption of mobile internet services has not kept pace with the expansion of network coverage (Mallik et al., 2020b). This has significantly shifted to alternate technology, such as USSD, to serve the underserved (Idriss & Ajiya, 2022). To contextualise mobile network evolution in the digital banking age, this study reviewed the evolutionary process of mobile technology from existing literature to provide a fundamental understanding of the invention of USSD technology (Lubis, Alexiou, & Nellis, 2019).

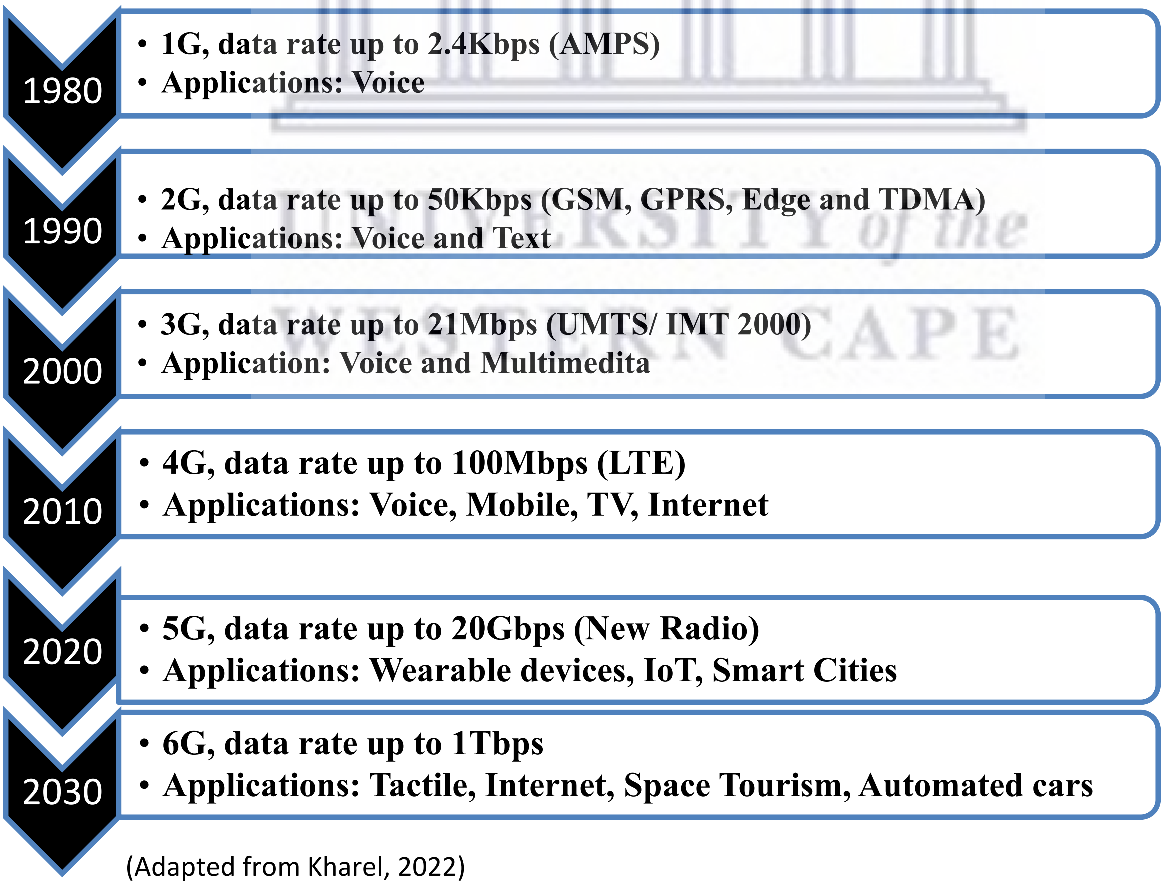
2.2.1 Mobile Technology Evolutionary Process (19th Century – Post Covid-19 Era)

Technological evolution encompasses theories that elucidate technological development (Iman, 2020). According to Merritt (2011), technological advancements have facilitated the expansion of mobile handset capabilities beyond the initial intentions of handset designers and wireless communication architectures. This has also resulted in the emergence of a promising avenue for mobile financial services, encompassing various functionalities such as bill payment and account transfers, domestic and international peer-to-peer transfers, proximity payments at the point of sale, and remote payments for purchasing goods and services (Shaikh et al., 2023). With technological innovations, an exciting transition has occurred within the banking and payment fields to deepen digital financial inclusion. This technological evolution has also evolved digital financial services, making them safer, faster, and cheaper (Carstens, 2020). Lubis et al. (2019) noted that developed digital financial services contribute to the nation's economy, socio-economy progress, and bank's ability to efficiently provide financial services to customers.

In the present context, contemplating a future in which mobile gadgets are absent might be considered a formidable task. Research has shown that mobile devices are ubiquitously found close to us, whether held in our hands, positioned on our desks, or kept in our pockets. Also, in the global service industry, several firms have made considerable financial commitments toward mobile phones, resulting in a diverse range of beneficial effects (Hanouch & Chen, 2015; Idriss & Ajiya, 2022; Mallik et al., 2020a; Mogaji et al., 2020; Perlman & Wechsler, 2019a). As cited by Kharel (2022), the advancements in mobile technology have greatly expanded the potential for productivity and cooperation via many means, including emails, document editing, instant messaging, and video chatting. Toward developing and investigating a USSD technology adoption framework for this study, which is a result of mobile technology evolution, it is essential to inquire about the factors that have led us to the current state of mobile technology innovation.

Due to its novelty and importance, the coverage was not as extensive as it is now (Shaikh et al., 2023). Furthermore, Leliopoulos and Drigas (2022) argued that mobile technology use cases have progressed dramatically during the last two decades from a call utility to a device through which various services can be performed. This phenomenon has transpired across several generations and is currently in progress. In recent years, the global significance of mobile wireless communication has increased significantly after the advent of 5G technology (Salih, Zeebaree, & Zebari, 2020). Numerous research provides a comprehensive analysis of mobile generations to delineate the distinct characteristics of each phase in the evolution of mobile technology. These research activities were accomplished by juxtaposing and elucidating the various attributes of mobile technology, such as type, data transmission rate, challenges, techniques, features, and applications employed in each phase, thereby facilitating a comparative assessment of the advancements made.

As illustrated in Figure 2.1, Kharel (2022) provides a historical overview of the previous generation of mobile technology networks and interprets what to expect from future generations. It is predicted that the current 5G and future mobile technology generations will transform the internet entirely with a massive impact on society and the industry far beyond IT (Kharel, 2022).



(Adapted from Kharel, 2022)

Figure 2. 1: Evolutionary Process of Mobile Technology

As mobile technology continues to evolve in the coming years and given the potential for more sophisticated mobile phone features and capabilities, it is likely that upcoming technologies, including mobile internet and beyond, will have the capacity to efficiently carry out the functions now performed by USSD (Hanouch & Chen, 2015). To add to this forward-looking contextual view, Leliopoulus and Drigas (2022) analysed four critical attributes of mobile technology evolution from 1G to 5G and beyond. This is presented in Table 2.1.

Table 2.1: Attributes of Mobile Technology Evolutionary Process

Attributes	1G	2G	3G	4G	5G
Year	1980	1990	2001	2010	2020 and beyond
Band Technology	Analog	Digital	Code division multiple access, Universal Mobile Telecommunications System	Long-Term Evolution Advanced, Wi-Fi	Multi-radio access technology, Giga Wi-Fi
Speed	2.4kbps	115 kbps	2Mbps	1Gbps	35.46 Gbps
Services	Voice	Digital voice, SMS, packet (General Packet Radio Service), low-rate data	Higher quality audio and video calls, mobile broadband	The high data rate, wearable devices	Very high data rate to fulfill extreme user demands, device-to-device, machine-to-machine, Internet of Things
Frequency Band	800MHz	900MHz	2,100 MHz 2	2,600 MHz	From 3GHz up to 90 GHz
Core Network	The public switched telephone network	The public switched telephone network Horizontal	Packet network	Internet	Internet

Source:(Leliopoulos & Drigas, 2022)

As presented in Figure 2.1 and Table 2.1, the ongoing advancements in mobile communication technologies facilitate the expansion of communication and its associated services to remote and expansive regions, requiring little ground infrastructure compared to wired systems. These are characterised mostly by 1G and 2G mobile networks. However, in this contemporary information age, there is a consistent growth in the demand for information services on the go, teleconferencing, large digital media exchange, etc., and to accommodate these demands, innovations in 3G to 5G network bandwidths carrying capacities and security have been receiving immense attention (Anachack & Darya, 2018; Kharel, 2022; Salih et al., 2020). Going into the future, literature (Leliopoulos & Drigas, 2022) suggests the emergence of digital economies and remote workplaces with hyper-connectivity will necessitate the attention of scholars and practitioners with a focus on mobile technology to pay attention on the impact of 5G and 6G mobile networks.

2.2.2 Future Perspective of Mobile Technology in Digital Financial Services

Since the inception of first-generation mobile phones, it is almost inconceivable to envision existence devoid of their presence. In contemporary times, mobile services have achieved extensive availability and are often used for personal and corporate purposes. Mobile service providers compete fiercely to recruit new users and expand their market presence. Currently, organisations globally provide several mobile services. The substantial expansion of these services underscores the significance of the prospective utility. Also, the present comprehensive state of mobile technology encompasses many devices such as mobile phones, PDAs, and tablets (Tehrani, Amidian, Muhammadi, & Rabiee, 2010). As mobile technology continues to evolve, the literature suggests the need to understand the importance of the future world in terms of the features and technical capabilities required for the next generations of mobile technologies (Leliopoulos & Drigas, 2022).

For instance, the world would require more virtual convergence, remote working due to the impact of COVID-19, and increasing internet access to perform mobile banking services (Anachack & Darya, 2018; Kharel, 2022; Salih et al., 2020). To corroborate the views of previous scholars on the future needs of mobile technology, the need to also understand its future adoption determinants like accessibility and affordability for digital financial services is essential (Anachack & Darya, 2018; Kharel, 2022; Salih et al., 2020). Despite the increasing prevalence and use of mobile technology, the challenges of cost and accessibility persist as barriers to its adoption among enterprises and people in developing countries, particularly those situated at the lower socioeconomic strata (Mallik et al., 2020a).

The Sub-Saharan Africa area has emerged as a prominent hub for mobile money operations on a worldwide scale due to the widespread adoption of mobile-based financial services, which accounts for an estimated seventy per cent of global mobile money transactions (as shown in Figure 2.2), with Nigeria, Kenya, and South Africa taking the lead in the region (Idriss & Ajiya, 2022).

Table 2. 1: Global Mobile Money Statistics (As of December 2021)

	Deployed and Live	Number of Registered Accounts	Number of Active Accounts	Transaction Volume	Transaction Value (US $)
GLOBAL	310	1.2 BILLION (+13% FROM 2019)	300 MILLION (+17% FROM 2019)	41.4 BILLION (+15% FROM 2019)	767 BILLION (+22% FROM 2019)
EAST ASIA AND THE PACIFIC	49	243 MILLION (+24% FROM 2019)	52 MILLION (+20% FROM 2019)	5.4 BILLION (+26% FROM 2019)	111 BILLION (+34% FROM 2019)
EUROPE AND CENTRAL ASIA	9	21 MILLION (+6% FROM 2019)	4 MILLION (+11% FROM 2019)	234 MILLION (+15% FROM 2019)	4.0 BILLION (+13% FROM 2019)
LATIN AMERICA AND THE CARIBBEAN	30	39 MILLION (+38% FROM 2019)	16 MILLION (+67% FROM 2019)	701 MILLION (+35% FROM 2019)	19.8 BILLION (+30% FROM 2019)
MIDDLE EAST AND NORTH AFRICA	29	56 MILLION (+9% FROM 2019)	3 MILLION (+35% FROM 2019)	146 MILLION (-63% FROM 2019)	10.5 BILLION (+26% FROM 2019)
SOUTH ASIA	36	305 MILLION (+5% FROM 2019)	66 MILLION (+5% FROM 2019)	7.5 BILLION (+8% FROM 2019)	131 BILLION (+10% FROM 2019)
SUB-SAHARAN AFRICA	157	548 MILLION (+12% FROM 2019)	159 MILLION (+18% FROM 2019)	27.4 BILLION (+15% FROM 2019)	490 BILLION (+23% FROM 2019)

Source: GSMA (2022b)

There has been a notable evolution in payment systems in recent years, transitioning from traditional cash or credit card transactions to a diverse range of mobile payment methods. As previously discussed, the transformation has occurred due to shifts in the economy, advancements in internet technology, the widespread use of social networks, and the growing utilisation of mobile devices (Rolfe, 2021).

Global organisations have also published several standards and guidelines to ensure technological innovations continue to drive the desired objectives for the digital financial inclusion agenda through low-cost technology such as the USSD technology. For instance, the publication of ten critical principles for systemically significant payment systems was undertaken by the Bank for International Settlement (BIS) in 2001. The essential characteristics of safety, trust, accessibility, efficiency, and interoperability are fundamental to properly operating an economy using low-cost technology (Feyen et al., 2021).

Given the widespread use of smartphones in contemporary society, customers are now experiencing advantages in terms of the simplicity and convenience associated with using these emerging mobile technology-based services (de Luna, Liébana-Cabanillas, Sánchez-Fernández, & Muñoz-Leiva, 2019). Mobile devices have emerged as very successful consumer items. In addition, the proliferation of mobile phones has brought many possibilities to the SSA region. Mobile phones and the accessibility of financial services via USSD technology have facilitated a more interconnected and socially engaged economy, spanning various urban and suburban areas, including enterprises of all sizes, and reaching individuals from diverse socioeconomic backgrounds (Josephs, 2023). According to GSMA research conducted in 2022 (GSMA, 2022b), the expansion of mobile payment is a remarkable result of mobile technology innovations that have substantially accelerated digital financial inclusion.

However, from a forward-looking perspective, the CBN noted that mobile payments have not fulfilled the early expectations as anticipated (CBN, 2019). Despite policy changes and continuous investments to achieve a cashless economy with a target of a ninety-five per cent financial inclusion rate, Mallik et al. (2020b) suggest a multi-disciplinary approach to investigate the complexity of technology interface trust in the service provider, associated risk with the technology, security, cost, user experience and privacy of valid information is required. Mallik et al. (2020b) support the assertions made by previous scholars (Adesina & Ayo, 2010) regarding the significance of promoting financial inclusion and facilitating digital financial services through USSD technology adoption. They propose a comprehensive examination of the factors influencing the adoption of cost-effective mobile technologies, such as USSD technology, to enhance the widespread utilization of mobile technology for accessing digital financial services.

An overview of USSD technology as part of mobile technology evolution is discussed in the following section. As technological innovation continues to transform digital financial services using low-cost mobile technology such as the USSD technology, as discussed in the previous section, it is also essential to understand its features and capabilities to establish its applicability to overall national digital financial inclusion strategy (Bech & Hancock, 2020) and to give consumer choice for the adoption as a legal digital financial services channel (Aechler & Moser, 2019).

2.3 Conceptual Review of USSD Technology

The Unstructured Supplementary Service Data (USSD) Technology, patented in 1994, is a communication technology within the Global System for Mobile (GSM) framework. It facilitates the transmission of text messages through combined strings consisting of alphanumeric and special characters. These messages are exchanged between a mobile phone and an application program within the owner network (GSMA, 2022a). They are now becoming vital to catalyse digital financial services adoption; hence, the attention received from scholars with research interests in DFS. In reviewing technology adoption for DFS, academics have posited that USSD has emerged as a viable option for facilitating financial transactions and promoting financial inclusion (Mogaji et al., 2020). To corroborate the usability of USSD technology for DFS, Josephs (2023) suggests that the use of USSD technology is aimed at reducing the need for customers to visit banking facilities to deposit money physically.

When comparing USSD technology with alternate technologies such as short messaging service (SMS), SIM Toolkit (STK, a programming environment embedded on the user's SIM card), and mobile internet to perform essential financial services. Dluhopolskyi et al. (2023) proposed that most mobile network operators (MNOs) and service providers prefer USSD technology. This preference is attributed to many causes, one of which is its extensive reach since it is compatible with a wide range of phones. User experience, security, cost, and ease of deployment for the provider are also essential considerations for adopting USSD technology to perform digital financial services (Hanouch & Chen, 2015). As mentioned in section 2.2.1, the USSD technology is a protocol integrated into the GSM and 3G/4G standards. It serves the purpose of transmitting data and allowing value-added services (VAS) across mobile networks.

The USSD protocol operates on a session-based model, which retains no data on the mobile device. Therefore, reliable access or constant accessibility can only be achieved when there is a vital communication connection between the mobile phone and a base station operated by a Mobile Network Operator (MNO). According to researchers focusing on mobile technology (Otor, Akumba, Idikwu, & Achika, 2020), USSD technology is activated either by users inputting a series of predefined star or hash/pound commands on the mobile handset or via a session initiated by the mobile network operator (MNO) or a service provider. Users are provided with a menu that is organized with numerical labels to enable them to use the mobile keypad to effectively reply to and submit any necessary data (Macharia, Pérez-Navarro, Inwani, Nduati, & Carrion, 2022).

Based on the GSMA trend analysis of USSD technology (GSMA, 2022b), there is an increasing inclination towards the use of USSD implementations in conjunction with developing technologies such as Digital Payments, Blockchain, Internet of Things (IoT) solutions, and Artificial Intelligence (AI). Despite being over 20 years old since its invention, USSD is not archaic and remains a relevant communication channel to drive an inclusive digital economy and deliver mobile technology-based services in emerging markets (Josephs, 2023), especially to low-income populations (Perlman &

Wechsler, 2019b). Following mobile technology evolution, research suggests its impact is yet to be felt. For instance, the Internet is still costly in most parts of the world for accessing essential services, especially in underdeveloped countries (Mallik et al., 2020b).

However, access to these services is gradually incorporating USSD technology. To corroborate Mallik et al. (2020b) on the shift towards USSD technology, Literature (Perlman & Wechsler, 2019) also suggests that low-income people in developing countries have a hard time earning enough to live and, hence, might not be able to access the internet. In GSMA (2022b), service providers in emerging markets developing mobile services for the mass market have been encouraged to look carefully at the opportunities USSD technology offers while collaborating with local mobile operators and regulators to foster adoption and usage. USSD technology is not the only digital financial services (DFS) communication service available. Other options include a short messaging service (SMS), SIM Toolkit (STK, a programming environment embedded in the user's SIM card), mobile internet, and newer innovations to interact with customers (Hanouch & Chen, 2015).

While GSM information networks are most secure and immune to destruction when distributed and decentralized, they are also most vulnerable to interception and unauthorized access (Weichbroth & Łysik, 2020). Due to the vulnerability of USSD, Wanuna (2020) proposes a dynamic knowledge-based authentication mechanism to boost the security of USSD transactions. Furthermore, the aforementioned attributes of USSD technology previously examined in section 2.3.2, various scholars also suggest some attributes of USSD technology for enhancement considerations. Some of these are summarised in Table 2.3.

Table 2.3: Attributes of USSD Technology

S/N	Attributes	Objectives	Summary of findings and citation
1	Enables self-service banking	To understand the impact of USSD technology's ease of use on its adoption	USSD is mostly self-service operated. USSD code consists of strings comprising of an asterisk (*), followed by a combination of digits (0 to 9) and a hash (#) such as *123*10#. The asterisk (*) and hash (#) codes signify the beginning and end of the request. It supports messages up to 182 alphanumeric characters in length (longer than 160 characters SMS) (Munene & Kasamani, 2017).
2	Enables financial Inclusion	To analyse the impact of USSD technology on financial inclusion	One primary benefit of USSD technology is its cost-effectiveness relative to other contemporary technologies. Additionally, it offers simple and

		due to low ownership cost	comfortable access for many clients residing in rural regions who may lack access to home internet or banking services. The USSD technology operates independently of internet connectivity, instead relying on GSM technology. This characteristic renders USSD more advantageous compared to using a mobile application in regions with restricted online accessibility. (Mogaji et al., 2020)
3	Drives a Cashless Economy	To evaluate the drivers and constraints towards a 'Cashless' Economy	The study explores supply-side dynamics in the adoption of USSD technology by reviewing DSF issues related to constraints and resource capabilities (David-West, Iheanachor, & Kelikume, 2018)
4	Enables Collaboration and Competition	To evaluate how USSD technology has fostered collaboration and competition between banks and MNOs	To evaluate the impact of USSD supremacy between MNOs and banks and to understand required interventions by regulators when it comes to disputes and performance (Hanouch & Chen, 2015)
5	Drive remote banking	To analyse the impact of using USSD technology to minimise physical presence at the banking halls	This research aims to analyse and design an information system that can effectively manage voucher card technology, similar to the existing network recharge card system. The primary goal is to minimise waiting and service times for users. Additionally, the simulation of the USSD communication protocol was conducted via a wireless link established between two computer systems, which assumes the roles of the user's mobile phone and the bank's deposit voucher system (Josephs, 2023)
6	Enable mobile health services.	To present a comprehensive analysis of the use of USSD technology as a cost-effective asset that enhances the	Ensuring cost reduction and facilitating the convenient availability of health information is essential for public healthcare workers (PHWs) and patients, including offline and online populations. These measures aim to provide equitable access to healthcare information, particularly for those

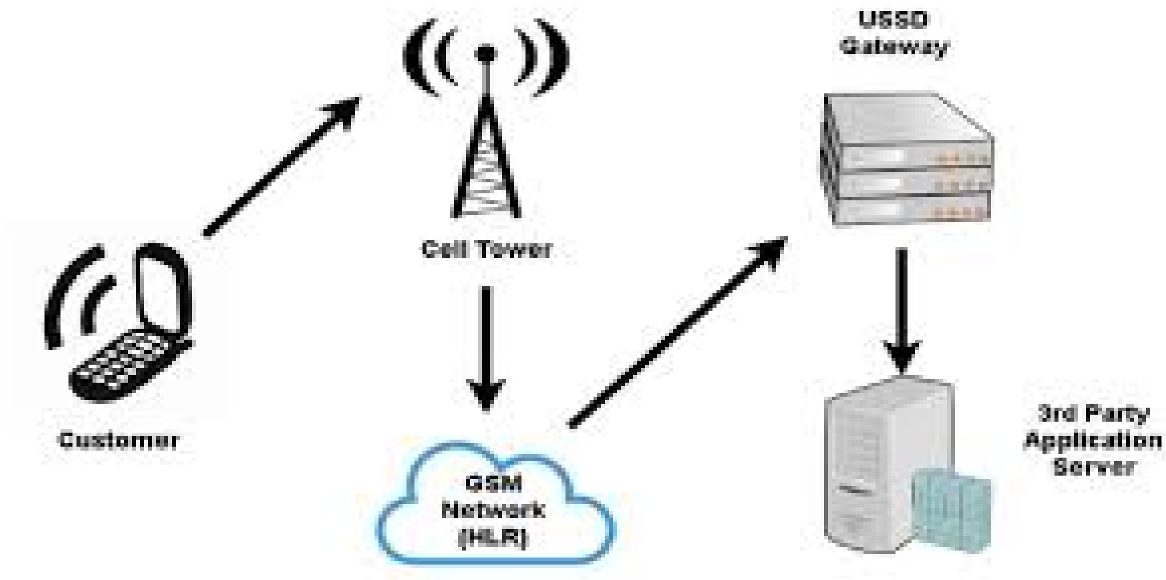
		work processes of public health employees.	residing in geographically distant areas with limited internet connectivity. The use of Unstructured Supplementary Service Data (USSD) technology has been seen in facilitating mobile money transactions via Ecocash, Telecash, and Onewallet services. However, its application in clinical data repositories remains limited (CDRs) (Zhou, Herselman, & Coleman, 2015).

Source: (Author's Review of Literature,2023)

2.3.1 How USSD Technology Works

According to Neza et al. (2022), research on technology adoption influenced by behavioural decisions requires a clarification of how the technology works to end users before adopting the technology. Different versions of how USSD technology works have been cited in the literature. Plain text messages are sent through either short messaging services (SMS) or a combination of USSD codes or numbers. However, these combinations of codes or numbers have different communication protocols between the mobile phone and the MNO gateway and can only access specific services (Anachack & Darya, 2018; Mallik et al., 2020b; Otor et al., 2020). USSD applications are menu-driven (that is, a short menu is presented for the user to select from), interactive (that is, the response is provided based on the chosen menu), and real-time (Otor et al., 2020). According to Tehrani et al. (2010), although the procedure and description might differ (Neza et al., 2022), they follow the same principles of USSD technology operation, which is standard across all GSM networks.

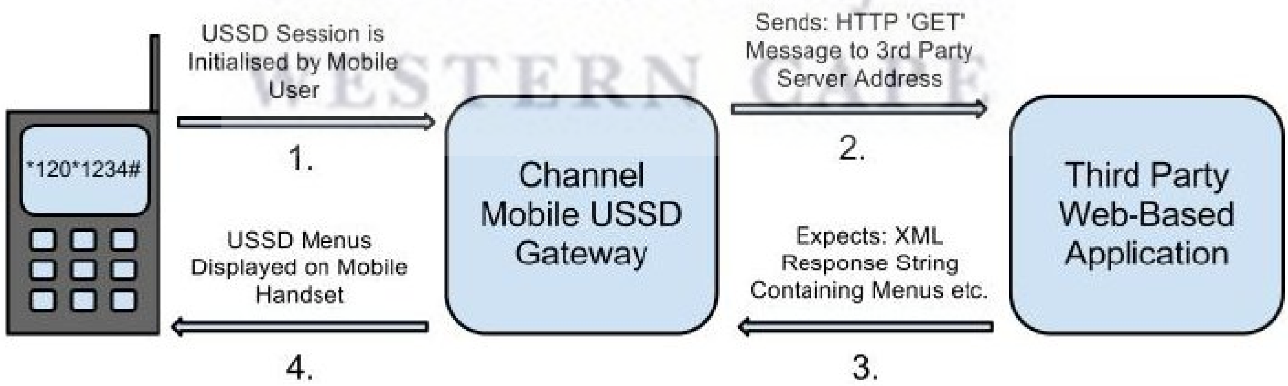
Their difference might depend on the acceptance of the mobile network platform they rely on for operation (Tehrani et al., 2010). USSD technology is mostly self-service operated. USSD code consists of strings comprising of an asterisk (*), followed by a combination of digits (0 to 9) and a hash (#) such as *123*10#. The asterisk (*) and hash (#) codes signify the beginning and end of the request. It supports messages up to 182 alphanumeric characters in length (longer than 160 characters SMS) (Munene & Kasamani, 2017). Based on the literature review on USSD technology architecture and basic process flow, the study presents a basic USSD architecture and basic USSD workflow as earlier presented by Mallik et al. (2020a). These are shown in Figures 2.2 and 2.3. Figure 2.2 illustrates a basic architecture of USSD technology, showing various components' interconnectivity in a typical USSD session. The USSD protocol establishes a real-time session between the mobile user and the USSD application platform upon invocation of the service. This session enables the exchange of data between the two parties until its termination. USSD can be implemented as either a push service, network-initiated service, or a pull service, mobile subscriber-initiated service.



(Adapted from Mallik et al., 2020a)

Figure 2.2: Basic USSD Architecture

In terms of basic USSD technology workflow, as shown in Figure 2.3, the user sends a USSD request to the USSD gateway by entering a short code on a mobile phone, the format of the code is standardized, and content is specified for each service, the content can be containing USSD code (Step 1). USSD gateway makes a session and routes information to a suitable application (Step 2). The application returns this information to the USSD gateway in XML form (step 3). USSD gateway makes a USSD message and sends it back to the user (step 4).



(Adapted from Mallik et al., 2020a)

Figure 2.3: Basic USSD Workflow

Typically, from a generalise workflow perspective, USSD involves a query from a mobile phone that contains a maximum of 182 alphanumeric characters; once the user sends the request, the USSD gateway forwards it to the user's USSD application, with a response to the request. The process is then repeated in reverse, i.e., the answer goes back to the USSD gateway, which displays the response's content on the user's mobile phone screen. USSD applications run on the network, not a user's device (Mallik et al., 2020b). As such, they don't have to be installed on the user's phone, an advantage for feature phones with limited storage space (Tehrani et al., 2010).

2.3.2 Features of USSD Technology

As discussed in section 2.3.1, the immediate gains for financial inclusion (driven by USSD technology) are clear. USSD technology is mostly self-service operated; for instance, users checking their airtime credit balance is one of the most common use cases of USSD technology. Users typically dial a short code on their phone, for example, #123*, and get access to a menu where they can check their airtime balance and other options. This study summarises USSD technology features as adapted from different literature focusing on USSD technology adoption. This is presented in Table 2.4.

Table 2. 4: USSD Technology Features

#	Features	Description
1	Number of characters	Supports messages of up to 182 characters in length compared to the 160 characters in SMS (Mallik et al., 2020b)
2	Connectivity	USSD messages travel from the user to the mobile network or vice versa. Instead of text messages going from user to user. USSD creates a real-time connection, which allows for a two-way exchange of data between users and the network (Macharia et al., 2022)
3	Real-time Communication	USSD creates real-time communication information exchange through a bidirectional dialogue. This makes the technology more responsive than SMS. (Mallik et al., 2020b)
4	Initiation	Mobile-Initiated USSD (also known as "pull"), which enables the customer to dial a number (e.g., *100#) to initiate a session via the handset. It can also be network-initiated USSD (also known as "push" or "mobile-terminating"), where the application starts the session on the mobile device (Otor et al., 2020)
5	Roaming	USSD messages are routed via the subscriber's home network; USSD services available to the subscriber remain available while roaming without any extra charges

		(Butler, Vijay, & Kibuuka, 2020)
6	Cost and Efficiency	USSD technology is cost-effective for accessing mobile-based services since it leverages existing mobile networks and protocols without additional subscription costs (Otor et al., 2020)
	Reliability	It does not depend on internet accessibility and can work in any remote condition. (GSMA, 2022a)
6	Confidential Information Storage	The USSD and STK protocols do not store any confidential information on the Mobile set (Butler et al., 2020)
7	Interactiveness	It allows businesses to reach and interact with customers via a low-cost, low-touch, and high-reach service channel (Tehrani et al., 2010)

Source: (Author's review of literature, 2023)

2.3.3 Limitations of USSD Technology

There is no perfect technology; they will keep evolving to address emerging consumer, regulatory, business, and other environmental trends (Butler et al., 2020; Mallik et al., 2020b; Otor et al., 2020). Because of the characteristics of continuous evolution and the need to meet recurring needs, USSD technology has limitations at every stage of its evolution cycle. As summarised in Table 2.1, the development of mobile technology has solved various limitations encountered by each mobile technology generation. Hanouch & Chen (2015) argue that USSD technology has less security than STK or mobile Internet. The user experience is also unpleasant (Hanouch & Chen, 2015). On the other hand, SMS is available on basic phones but delivers a less secure, less intuitive, and more challenging user experience than USSD (Mallik et al., 2020a). Also, USSD technology exposes customer-sensitive information such as the personal identification number (PIN).

In the views of Otor et al. (2020), this does not allow for privacy and thus increases the risk and possibility of fraud (Otor et al., 2020). Another limitation is the issue of cost and perceived trust. USSD sessions may be cancelled, increasing transaction costs and undermining customer trust (Hanouch & Chen, 2015). Despite these and other concerns, Hanouch & Chen (2015) opined that the majority of digital financial services providers such as bKash in Bangladesh, WING in Cambodia, EasyPaisa in Pakistan, ZAAD in Somalia, M-PESA and Tigo Pesa in Tanzania, and EcoCash in Zimbabwe, rely on USSD technology to provide their services. M-PESA in Kenya is a rare exception that uses STK technology in combination with encrypted SMS. According to GSMA (GSMA, 2022a), numerous attractive alternatives cannot expand because most low-income users do not yet have internet-enabled phones, an essential requirement for mobile Internet (Hanouch & Chen, 2015).

2.3.4 Use Cases of USSD Technology

The prevalence of branchless banking, which offers convenient and accessible services at any time and location, has resulted in a decline in the prominence of traditional branch banking (Esmaeili et al., 2021). Consequently, the use of mobile devices has largely revolutionized the landscape of Internet banking (Shaikh et al., 2023). The banking sector is seeing a growing use and need for USSD-based financial services; several studies have been undertaken on USSD technology adoption due to its widespread acceptance as the ideal channel for mobile banking and mobile commerce services, especially in Sub-Saharan Africa (Austin-Oluwo. et al., 2023). USSD technology has been used by businesses, regulators, and key industry players to allow citizens access to essential services. Examples of services offered by USSD include sports updates, weather reports, news, marketing and promotions information, reservation applications (for planes/trains/ movies, etc.), voting/polling applications, mobile banking, airtime top-up, and marketing updates, among others.

According to Sim (2017), USSD is one of the channels enabling a digital economy. The technology has been used in emerging markets for over a decade and is sometimes considered the 'ancestor' of mobile apps. Where societies and businesses are grossly affected due to the lack of internet, technology start-ups looking to target a broader audience are looking beyond internet-based means through USSD technology to circumvent these limitations. According to Sim (2017), USSD technology was initially used by mobile operators for self-care in emerging markets. However, the number of use cases has grown exponentially in emerging markets due to the economic potential of providing access to local developers and entrepreneurs, and they have launched various initiatives after that. In past literature, to offer multiple services to a diverse population in emerging markets, interested stakeholders and technology start-ups developing mobile-based services for the mass market should adopt USSD technology to unlock numerous opportunities (Sovania & Erasashanti, 2020).

Due to its ubiquity and broader use across multiple sectors of the economy, USSD technology is adaptable to any personal and business requirements. Tehrani et al. (2010) suggest that the intent and purpose of usage determine the application of USSD technology for various use cases. This study summarises multiple use cases that can be accessed through USSD technology, as shown in Table 2.3.

Table 2.5: Summary of Use Case of USSD Technology

Use Case	Literature Reference & Citation	Example
Self Service	**A quantitative study on Mobile Technologies for Health** (Sim, 2017)	• Mobile self-service • Service registration & queries • Verification of product authenticity • Reservations & support
Financial Services	**A content analysis of Digital finance research and developments around the world**(Peterson K. Ozili, 2023) **A qualitative study on USSD Digital Wallet design and adoption** (Mallik et al., 2020b)	• Mobile banking, Balance inquiry, Mini statement • Payments and transfers • Remittance • Pay beneficiary (customer and client-defined) • Money Transfer • Change PIN • Prepaid top-up • Peer-to-peer payments • Bill payments
Information Services	**A study on the design and analysis of a Tea Farming Information System** (Munene & Kasamani, 2017)	• News, weather, sports updates, stock market, etc.
Marketing and Social Services	**An investigation of the various system platforms used for mobile payment** (Tehrani et al., 2010) **A quantitative review of customer loyalty in mobile banking: Evaluation of perceived risk, relative advantages, and usability factors** (Esmaeili et al., 2021)	• Voting contests and polling • Customer surveys • Marketing surveys

Source: (Author's review of literature, 2023)

With the conceptual review of USSD technology and applicable use cases discussed in this section, it is essential to examine the digital financial services ecosystem in which this study focuses on improving USSD technology adoption. The following section presents a review of the digital financial services ecosystem.

2.4 The Digital Financial Services (DFS) Ecosystem

As discussed in the previous chapter, digital financial services (DFS) continue to emerge as a prominent topic in the contemporary global economy due to their importance to an inclusive digital economy (Obiora & Ozili, 2023) and to ensure consistent growth of mobile-enabled digital banking services (Van-Niekerk & Phaladi, 2021). With DFS's increased relevance to society, literature provides an array of DFS definitions suitable to the research context. For instance, Ayman (2021) defined digital financial services (DFS) as a comprehensive array of financial services that are accessible and offered using digital means. They facilitate various economic activities, including payments, savings, remittances, and insurance (Ngwengeh et al., 2021). In Perlman & Wechsle (2019a), DFS has been defined as a platform that offers various means to access banking and other non-banking transactional services using mobile or electronic media.

In providing digitally enabled financial services such as savings, insurance, and credit facilities, which are crucial for business expansion, risk management, and future planning, there have been a plethora of fintech-driven digital financial services (Idriss & Ajiya, 2022) with proven outcomes and results to provide economies of scale, enhance the velocity, security, and transparency of transactions to underserved populations (EFInA, 2021). The provision and use of essential digital financial services improve economic well-being, bolster resilience, and enhance the quality of life for those financially excluded (Pazarbasioglu et al., 2022). According to the World Bank Group (World Bank Group, 2020), the availability of cost-effective digital financial services plays a crucial role in eradicating poverty and promoting economic progress. Nations characterized by more robust and advanced financial systems tend to have elevated levels of economic development and notable decreases in poverty rates and income inequality.

Although various technological innovations address the contemporary challenge faced by commercial banks to digital financial exclusiveness within society, namely the decline in profitability resulting from intense competition, particularly from the telecommunications sector (Rikhsiboyevich & Axrorovna, 2021), Perlman (2017) argues that implementation of various DFS products and services ushers in the adoption of a low-cost mobile technology to improve the accessibility and affordability of essential financial services to drive financial inclusion. It shifts the provision of financial products and services from primarily banks to non-banks using a mobile phone (David-West et al., 2018).

Although much research has been conducted to review digital financial services implementations in developing countries, the concept of DFS leveraging mobile technology innovations has been described as an enabler of digital financial inclusion (Ayman, 2021).

According to Perlman &Wechsler (2019a), literature on digital financial services (DFS) driven by mobile technologies is among the top 5 themes in academic research focusing on financial inclusion and accessibility to essential financial services. It has also received significant attention from global corporations like the United Nations (UN) and the World Bank due to its propensity to increase financial inclusion (World Bank Group, 2020). Similarly, in the last five years, global organisations have paid significant attention to issues on digital financial services because it is one of the pillars of achieving the United Nations 2030 sustainable development goals (GSMA, 2022b). As the digital and mobile technology revolution continues to change the landscape of the financial services industry at an unprecedented rate, the emergence of fintech (or financial technology) has fuelled the development of a wide range of new digital financial products and services (DFS) across many countries (Lyons & Kass-Hanna, 2022).

While their emergence can be related to the recent fintech movement, it is essential to point out that the financial industry has a long history of reliance on mobile technology evolution. As discussed in previous sections of this chapter, the global implementation of Digital Financial Services (DFS) has generated prospects for enhancing digital financial inclusion and extending services to previously neglected or underserved sectors of the population by conventional financial service providers (Lyons & Kass-Hanna, 2022). In the argument of other scholars, the COVID-19 pandemic also amplified the need for a deeper understanding of DFS expansion in emerging markets (Austin-Oluwo. et al., 2023). In the same line of thought, Lyons & Kass-Hanna (2022) suggest that the pandemic has bolstered the potential for enhanced inclusive society via digital financial services (DFS). According to Bagli & Dutta (2014), an inclusive society is described as a society that is included financially, socially, and economically with affordable access to digitally enabled services.

Also, in no particular order of contextual preference, previous scholars have discussed digital financial services basically as a service offering and platform to drive digital financial inclusion (Ahmed, 2022; David-West, 2020; Peterson K. Ozili, 2023; Perlman, 2017; Perlman & Wechsler, 2019b; Supervisor & Šavriņa, 2020). Regarding service offerings, Khan & Siddiqui (2019) suggest that accessibility to affordable digital financial service offerings promotes emerging countries' financial and economic healthiness. Similarly, Perlman (2017) opined that DFS encompass a range of financial service offerings provided by various entities, including banks, non-bank third-party providers, mobile network operators (MNOs), and service providers (SPs). These services, which include payment solutions, savings accounts, loans, and insurance products, are facilitated through digital technologies and electronic platforms such as mobile phones, the Internet, and electronic cards.

In the review of DFS as a platform to accelerate digital financial inclusion, Riha Parvin & Panakaje (2022) posit that DFS is the most well-known in the international development sectors, having received recognition from the G-20 country leaders, corporations, and governments all across the world and the World Bank, and with its capability to enhance digital financial inclusion (Nepal & Nepal, 2023). In a study of digital banking and other payment solutions adoption determinants in Nigeria, Olaolu (2022) argues that mobile technology continues transforming the digital financial services sector. Perlman & Wechsler, (2019b) opined that, as mobile technology innovation continues to provide ubiquity and expansion of basic mobile coverage across emerging and developing countries, mobile phones have evolved from an essential telecommunications utility of calls and messages to that of a new enhanced role as a payment platform.

To corroborate Olaolu (2022) and Perlman & Wechsler, (2019b), Ozili (2023) suggests continuous technological innovation enables the evolution of DFS platform and services offerings and catalyse non-bank players to intensify efforts to complement bank-led DFS offerings to bank the "unbanked" population (Perlman & Wechsler, 2019a). According to Ozili (2023), DFS has contributed to the Gross Domestic Product (GDP) of developing and emerging countries and job creation across all sectors, providing for over 2 billion unbanked adults worldwide. Arguably, As a platform to access basic financial services and improve digital inclusion, research suggests DFS has rapidly become a ubiquitous and affordable platform to access basic financial services such as money transfer, airtime top-ups, account balance, account opening, contributions, crowdfunding, etc. (Perlman, 2017).

In the review of India's digital financial infrastructure comprising of components such as a national digital biometric identity (called Aadhaar) and a digital payment platform, the DFS platform offering has helped more individuals into the digital financial inclusion space by utilising both application-based smartphones and unstructured supplementary service data (USSD) based feature phones (Ray et al., 2022). According to Rikhsiboyevich & Axrorovna (2021), the rising need for a digitally inclusive economy results from the demand for new mobile-enabled digital financial services within the banking ecosystem. Similar to the views of Rikhsiboyevich & Axrorovna (2021), Nepal & Nepal (2023) suggest that understanding the DFS ecosystem requires a review of various actors and activities that interplay to enable adoption. From an ecosystem perspective, numerous studies have examined DFS from different contexts.

For instance, using the green innovation approach, Li, Sun, Gao, & Cheng (2023) suggest that DFS provides equal opportunities and the principle of business sustainability to all actors of the economy. Similarly, with various actors and players' ongoing digitalisation of the economy, DFS remains a catalyst to transform traditional financial institutions, particularly banks leveraging mobile technology (Wachira, Kalui, & Gathii, 2021). Similarly, the increase in low-cost mobile phones has enabled digital financial service providers (DFSPs), banks, and mobile network operators to develop a DFS ecosystem to provide ubiquitous and low-cost digital financial services (Perlman & Wechsler, 2019a). Following a comprehensive examination of the progression of technology and the advancements made in the realm of Digital Financial Services (DFS), Perlman (2017) argued that the ability of service providers to offer DFS at scale is based on mobile technology evolution factors.

Currently, mobile technology has significant prominence within the DFS ecosystem. Consequently, several financial institutions worldwide embrace its evolution and innovation while capitalizing on its benefits (Kassaye, 2023). However, examining the interplay of activities and actors is crucial to determine the critical elements necessary to make the DFS ecosystem efficient and effective in realising the promise of digital financial inclusion (Perlman, 2017).

2.4.1 Actors and Activities in the Digital Financial Services Ecosystem

An ecosystem is characterised by the presence of interdependent relationships and interactions among multiple participants(actors) and related activities governed by a specific set of rules and standards (Pant, 2018). These interactions among actors and associated activities performed by these actors introduce some form of complexity in an ecosystem (Chaveesuk, Khalid, & Chaiyasoonthorn, 2021). Why is the study of a DFS ecosystem critical? According to the World Bank, digital financial services are a systematically important component of an economy, and Its inefficiency could adversely affect the functioning of the economy (World Bank Group, 2020). As cited by Pandey & Zheng (2023), the successful management of the intricate aspects of digital financial inclusion necessitates adopting a multidisciplinary strategy, which involves the comprehensive analysis of diverse interdependencies of various stakeholders within the ecosystem.

This interdependence also exists in a digital financial services ecosystem, bringing simultaneous competition and collaboration (a term referred to as coopetition) among stakeholders to achieve digital economy benefits (Dara, 2018). Usually, the DFS ecosystem is predominantly dominated by incumbent banks and other financial institutions (Lee, Wewege, & Thomsett, 2020). However, emerging players such as FinTech, Mobile Network Operators (MNOs), and Neobanks, which can be referred to as Digital Financial Services Providers (DFSPs), are beginning to gain their share of the market using innovative mobile technologies that are robust, relatively new and data-driven (Perlman, 2017). Iriobe et al. (2021) opined that the participation of these new players has also increased the ecosystem's complexity.

In a further review of the DFS ecosystem interplay, Lyons & Kass-Hanna (2022) suggest the DFS ecosystem is undergoing a significant transformation due to the rapid advancements of the digital revolution and the advent of fintech (also known as financial technology) players. These entities continue stimulating digital economy innovation and the development of novel digital economic goods and services (Krivosheya & Belyakova, 2019). According to Han & Wang (2021), from early 2019 till now, research focusing on digital financial services and payment systems has also shown the significant importance of the DFS ecosystem study. This also aligns with the views of Brown et al. (2020) and BIS (2022), who suggest that the stability of the DFS ecosystem depends on the interplay between actors and the smooth running of businesses and economies.

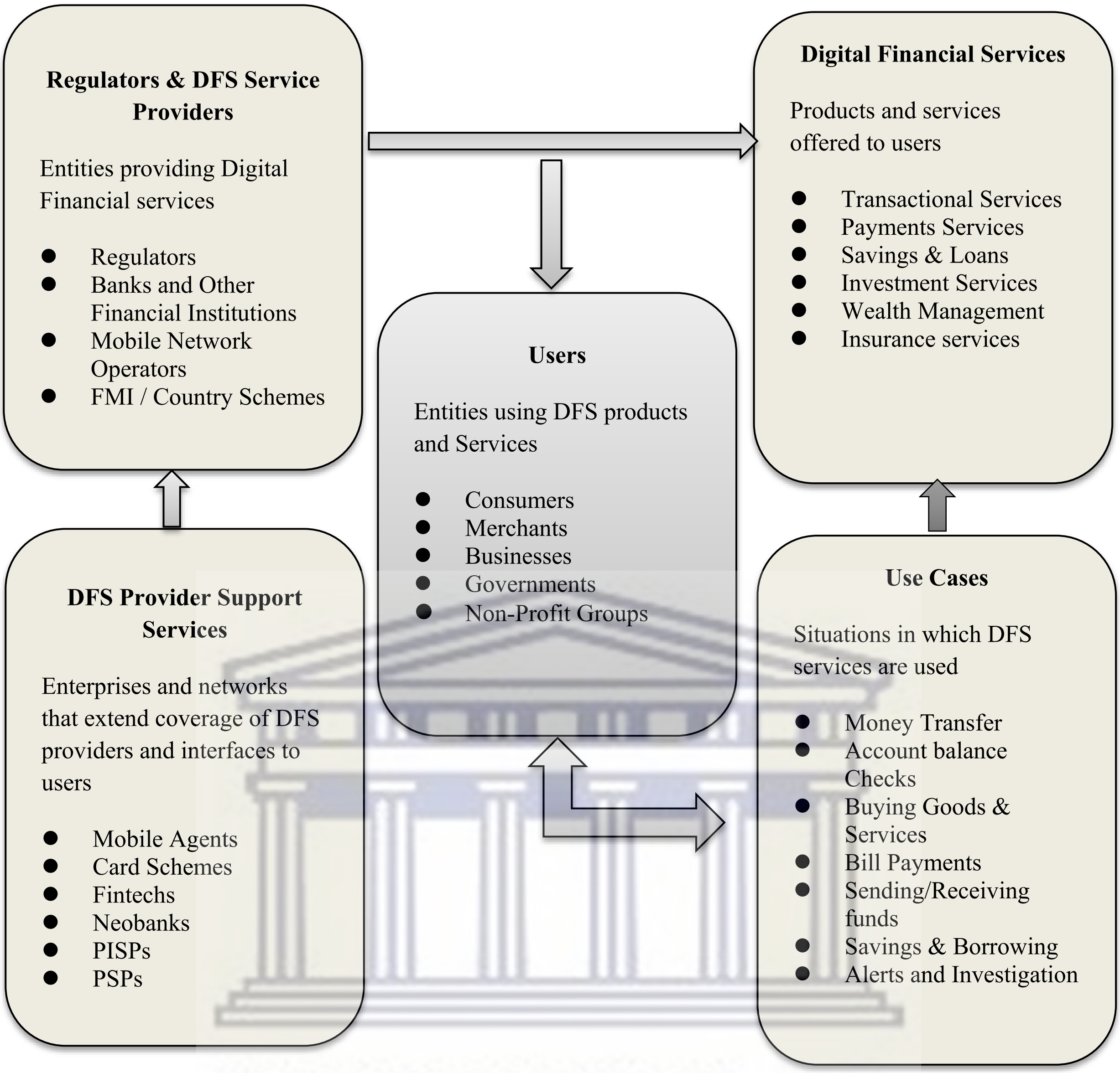
For a better understanding of complexities within an ecosystem, Harasim & Klimontowicz (2013) suggest that a two-sided ecosystem approach in terms of actors and activities should be adopted to study interactions within an ecosystem. In the review of actors and activities within an ecosystem, Pant (2018) suggests that the interaction among these actors is characterised by the standards of the applied technologies, business models, and governing laws (Lee et al., 2020). To corroborate Pant (2018), Harasim & Klimontowicz (2013) suggest that competition and, more in general, the complexity of the DFS landscape is significantly increasing between incumbents and new entrants willing to reach the mass market using cutting-edge technological infrastructures (Han & Wang, 2021). In a further review of the interplay of fintechs, neobanks, payment service providers (PSPs), and payment initiation service providers (PISPs) as active players in the DFS ecosystem, Afjal (2023) performed a bibliometric analysis of their role in promoting financial access and economic development between 2010 and 2023.

Findings from the research reveal that they are becoming essential actors in significantly increasing digital financial inclusion and fostering economic growth. Further findings indicate an increasing cross-disciplinary fascination with FinTech and financial inclusion, accompanied by a notable rise in scholarly output starting in 2016. This surge underscores the importance of digital financial services in mitigating the constraints associated with conventional financial institutions (Afjal, 2023). Having realised the importance of ecosystem interplay among various participants in the DFS ecosystem, the Digital Financial Services (DFS) working group of the International Telecommunication Union (ITU) established the Focus Group on Digital Financial Services (FG DFS) in 2014 to cultivate and enhance the interconnectedness among various participants within the DFS ecosystem. This group comprises 60 organisations from 30 countries (Butler et al., 2020).

According to Butler et al. (2020), the ITU digital financial services focused group's activities have been characterised by collaboration on policy enhancements, technological innovations, and the incubation of strategic ideas to promote access to affordable mobile technology-based services. Furthermore, the group's primary aim is to strategically foster relationships between telecommunications and financial services regulators, banks, and MNOs and to address significant issues on DFS interoperability, consumer protection, competition issues, regulation for DFS, security of transactions, quality of service, big data and digital identity (Perlman, 2017). A similar approach has been taken in Nigeria following the collaboration between the CBN and the NCC to foster interoperability and synergies between banks and mobile network operators. Based on the proposed USSD technology adoption framework for the study, the interplay of actors mentioned in the earlier sections of this chapter plays a vital role in the investigation of each of the constructs of the framework.

With several issues underpinning the inefficiencies of retail payment markets, it is essential to understand retail payment systems' prospects for adoption, usability, applicability, and relevance from an ecosystem perspective. In light of the present DFS ecosystem complexities, Lyons & Kass-Hanna (2022) suggest it is of utmost significance for scholars and financial practitioners to cultivate a more profound comprehension of the growing nature of Digital Financial Services (DFS) ecosystem, understand the interaction among actors and as well as the associated advantages and hazards faced by those with lower socioeconomic level and inadequate digital literacy. From a country-level perspective, access to finance is the main issue for emerging countries' financial health and economy. Digital financial services provide SMEs with numerous opportunities to adopt digital financial services, cut costs, and increase their profitability and financial health. SMEs (Khan & Siddiqui, 2019).

Also, drawing from previous literature on the ecosystem view of digital financial services actors and players and their interplay within the DFS ecosystem, this study presents a typical DFS ecosystem, as shown in Figure 2.4. As shown in Figure 2.4, individuals and business consumers are at the centre of the interactions among all actors and various activities performed by these actors. The outcome of their interactions directly impacts entities using DFS products and services.



(Adapted from David-West, 2020)

Figure 2.4: A Digital Financial Services Ecosystem

According to Polasik et al. (2020), literature on mobile technology innovations and digital financial services has explored the regulatory, business, and technical aspects within a complex DFS ecosystem of incumbents and new market entrants, which exists today. However, due to regulatory recognition of actors in the DFS ecosystem and their roles in the delivery of the national and global financial inclusion agenda, key drivers of digital financial inclusion strategies and digital economy dis-intermediation capabilities literature (Purnomo & Khalda, 2019) suggest a comprehensive study regarding the factors determining the potential co-existence of all these actors within the ecosystem is of great importance (Iman, 2020). Based on actors and the interrelationship of their activities in the USSD technology adoption framework for this study, Table 2.6 presents a summary of the list of actors and the roles they play in terms of products or services offered.

Table 2. 2: Summary of Actors and their Activities in a DFS Ecosystem

Actors	Activities
Users, Individuals, and Corporate Organisations	• Act as the ultimate consumer of DFS products and services • Payer for DFS services transactions and the payee for others (in the case of bill collections) • Determine the type of payment to be initiated or products/services to be consumed
Central banks and other regulatory bodies	• Provide oversight on policies and regulations • Ensure the ecosystem is safe and secure • Ensure consistency in the operationalisation of the DFS ecosystem
Fintechs, Neobanks, Payment service providers (PSPs), payment infrastructure providers (PIPs), and payment imitators (PIs)	• Leverage available infrastructure for payment initiation • Drive innovation using advanced technologies • Provide alternative banking services, including bill payments, alternative payment channels, and funds transfer services.
FMI / Country Schemes	• The operator of payment systems (e.g., clearing-houses), low /large value payment systems, and payment switches • Provide payment infrastructure for
MNOs	• Provide the voice and data communication network • Enable consumers to initiate USSD sessions • Ensure end-to-nd security of the network
Banks	• Account opening, wealth management, savings and loans, interbank transfers, trade, and finance • Liquidity management for other non-bank players • Issue payment instruments • Constitute the supply side of the DFS chain
Card Scheme Providers (Visa and MasterCard)	• Ensure consistency in the global processing and settlement of credit and debit card transactions.

Source: (BIS, 2021a; Feyen et al., 2021; Iriobe et al., 2021; Yeh, 2020)

Based on the discussions above, it is apparent that a dynamic shift is occurring within the digital financial services landscape, using mobile technology as a catalyst. (Shaikh et al., 2023). As the DFS ecosystem continues to evolve with existing players and new market entrants leveraging USSD technology, research suggests that DFS actors are increasingly moving towards a digitalized value generation. Consequently, partnerships become more accepted and valued to re-bundle innovations and shared economy services (Pant, 2018). The following section will discuss the Nigeria DFS ecosystem and the adoption of USSD for digital financial services.

2.5 Nigeria's Experience of USSD Technology Adoption for Digital Financial Services

Despite the increasing volume of scholarly research on digital financial services within the Nigerian banking industry, there is a prevalent dearth of comprehension about its transformation and evolution based on definition, goals, constituent elements, technological instruments, and regulatory implications (Peterson K. Ozili, 2022). However, it can be assumed that scholars and practitioners in the banking and financial services domain have diverse viewpoints about USSD technology adoption for DFS in Nigeria (Kassaye, 2023). According to Iwedi (2023), the increasing prevalence of financial transactions and payments conducted via cell phones and mobile money stores has brought to light the significant potential of USSD technology adoption in promoting financial inclusion via digital banking technology. The implementation of the cashless policy by the Central Bank of Nigeria has also significantly improved the lives of several Nigerians, as seen by the success of the cashless policy implementation (Iwedi, 2023).

Nigeria has over 220 million people and is crucial in Africa's digital financial services landscape. It is one of the leading countries in Africa with the highest number of fintechs and banks with regional presence in other parts of Africa, with about 60% adult population and about 80% mobile phone penetration among them. It boasts one of the largest populations of youth in the world. To investigate how digital financial services impact Nigeria's economy through Nigerian deposit money banks (DMBs), Austin-Oluwo. et al. (2023) performed an expo-facto data analysis on independent variables of digital financial services, which includes volume of ATM transactions (VATM), volume of POS transactions (VPOS), volume of WEBPAY transactions (VWBP) and volume of mobile banking (VMOB) regressed on Gross Domestic Product (GDP) as a dependent variable. The study's findings indicate a favourable correlation between the amount of mobile banking, point of sales, and automated teller machine transactions and the economic growth of Nigeria (Austin-Oluwo. et al., 2023).

The roll-out of the Global System of Mobile (GSM) Communications in Nigeria in 2001 and the introduction of mobile money in 2009 has resulted in an upsurge of mobile technology adoption for banking services and how banking is conducted today (CBN, 2019). With this development, various technological innovations have significantly contributed to the uptake of mobile financial services in Nigeria, including USSD technology (Olaolu, 2022). From publicly available data through the NIBSS website, there has been a considerable growth of mobile-enabled transactions processed through

NIBSS instant payment platform digital payments, with mobile channels contributing over eighty per cent of these transactions across the instant payment platform shown in Figure 2.6. Although various institutions adopted USSD for different use cases in the last ten years, Mogaji et al. (2020) cited a significant uptake of USSD in Nigeria's DFS ecosystem after the launch of USSD codes by major bank players.

Some examples of these codes are First Bank *894#, First City Monument Bank (FCMB) *389*214#, and Guaranty Trust Bank (GTB) *737# (Mogaji et al., 2020). Despite the increased adoption of USSD technology, the country still has about thirty-six per cent % digital financial exclusion rate (as of December 2022) and high charges for USSD-enabled banking services (EFInA, 2021). This is also evident in the Central Bank of Nigeria's payment system Vision 2030 document published in 2022. A similar view operates across most African countries, driving various digital financial inclusion agendas. These facts align with findings from previous studies that, although players within the DFS ecosystem in developing countries provide a full array of financial services through their interactions (Austin-Oluwo. et al., 2023)., uptake of digital financial services, notably mobile money, is still low due to the preference for cash operations as well as high cost and trust issues (Wezel and Ree, 2023).

These high charges have often resulted in technology adoption resistance for DFS or the escalation of disputes from mobile network operators who enable banks to offer the USSD session to their end consumers and banks. When this happens, USSD transaction charges are slightly increased by banks (Austin-Oluwo. et al., 2023). Ultimately, this escalates affordability challenges for rural populations with high contributions to the population pool. Affordability and accessibility issues became evident based on the EFInA's report on Access to financial services in Nigeria. According to EFInA (2021), Nigeria's financial exclusion rate stands at thirty-six per cent against a 5% target by 2025, as indicated by the CBN (CBN, 2019). However, a critical component of the CBN and NCC alliance is to improve accessibility and affordability of digital financial services among Nigerians leveraging low-cost technology such as USSD (Wezel and Ree, 2023)

This is evident in the escalation of disputes between mobile network operators and banks over unpaid bills, pricing models, and the considerable cost of service levied on USSD services to banking customers. The disagreement, which lasted for several months between 2021-2022, led to the increase in USSD session charges, which also caused service disruptions and the incremental cost eventually passed down to consumers. As such, USSD charges were slightly increased by banks. This resulted in affordability challenges for rural populations with high contributions to the population pool. Affordability and accessibility issues became evident based on the EFInA's report on Access to financial services in Nigeria. According to EFInA (2021), Nigeria's financial exclusion rate stands at thirty-six per cent against a 5% target by 2025, as indicated by the CBN (CBN, 2019). However, a critical component of the CBN and NCC alliance is to improve accessibility and affordability of digital financial services among Nigerians leveraging low-cost technology such as USSD (Wezel and Ree, 2023).

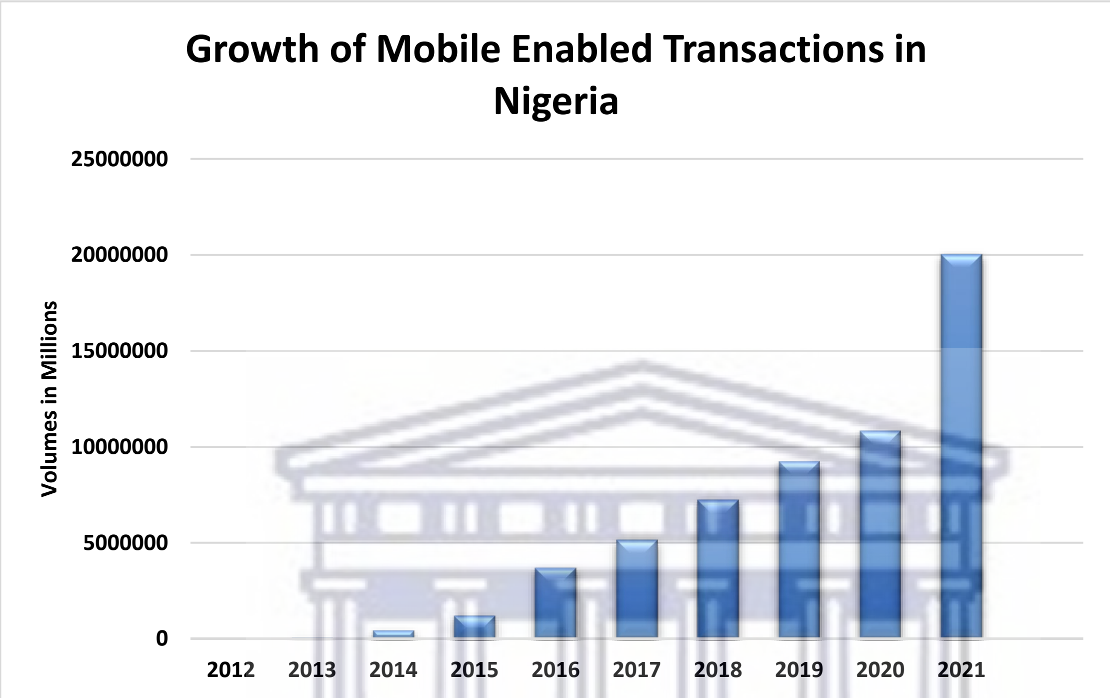


Figure 2.5: Growth of Mobile-Based Transactions on NIBSS Instant Payments Platform (Source: NIBSS Website)

Despite these remarkable achievements in the Nigerian banking and telecommunication sectors, little has been achieved in generalizing these successes compared to the Nigerian population that can afford and access digital financial services. Previous researchers have debated the applicability of USSD technology to leapfrog digital financial services inclusion in Nigeria, which will be discussed in the next section.

2.5.1 Literature Review of USSD Technology Adoption in Nigeria

Information system (IS) researchers focusing on technology adoption have comprehensively examined scholarly publications across diverse fields such as business, marketing, retail, consumer behaviour, information systems, and transdisciplinary journals. This evaluation aimed to identify pertinent papers and empirical discoveries about adopting novel technologies, such as USSD technology, and its implications for digital financial inclusion (Yaqin & Safuan, 2023). Furthermore, these research activities identified research gaps and recognised necessary enhancements in adopting and using USSD technology (Bankole, Bankole, & Brown, 2011). Globally, financial institutions have introduced diverse programs and services, such as mobile banking, to enhance the overall banking experience for their clientele. However, Mamun et al. (2023) have cited that a significant portion of the population has reservations about adopting new mobile technology for digital financial services.

Consequently, a dearth of awareness and comprehension exists about the potential of adopting new mobile technology. Also, many people remain uninformed about the convenience, compatibility, and variety of USSD technology that offers digital financial services (Yaqin & Safuan, 2023). This global phenomenon explains consumers' tendency to adopt USSD technology within the Nigerian banking industry. According to Austin-Oluwo et al. (2023), USSD technology is an innovation within the Nigerian banking industry that provides easy, timely, and affordable access to basic financial services, contributing to Nigeria's digital financial inclusion and socio-economic development. Austin-Oluwo. et al. (2023) also noted that the benefits of USSD technology for digital financial services in Nigeria include enhanced financial inclusion for low-income individuals and decreased costs of financial intermediation facilitated by technology providers.

In Ozili (2022), digital technologies, such as USSD technology, have been cited to play a crucial role in expediting the process of digital financial inclusion. This concept pertains to enhancing the availability and affordability of formal financial services for those historically excluded from such services. By leveraging digital technologies, particularly USSD technology, efforts may be made to integrate economically disadvantaged populations into the formal financial sector of the economy (Kassaye, 2023). According to Mallik et al. (2020a), USSD technology helps create a digital payment solution that bridges the gap between technology and banking using an open-source web enabler in the form of an Application Programming Interface (API) (Mallik et al., 2020a). In the views of Iwedi (2023), USSD technology has enhanced operational efficiency and cost reduction within financial activities. This innovation has also facilitated increased frequency in the opening and real-time access to consumers' accounts. USSD technology, enabled by mobile network operators (MNOs), has provided a means for many individuals in Nigeria to access digital banking services. Iwedi (2023) further noted that USSD technology adoption has proven beneficial for those who own a mobile phone but do not possess a conventional bank account.

By leveraging the value of their airtime, these individuals can engage in financial transactions such as money transfers, bill payments, and insurance premium settlements. Evidence from the research indicates that USSD has the potential to bring financial inclusion to the majority of people without broad internet access (Mallik et al., 2020a). Research spotlight on generalised mobile banking and mobile payments adoption literature has also been on the DFS ecosystem. As USSD technology innovation continues to catalyse growth and competitiveness in the digital financial services ecosystem, Wachira et al. (2021) noted that several studies have also focused on adopting and using mobile technology-enabled services in Nigeria. A summary of some of the literature with a focus on mobile banking adoption within the Nigeria DFS ecosystem is summarised in Table 2.7.

Table 2. 3: Literature Review of Mobile Banking Literature focusing on Nigeria's DFS Ecosystem

Researchers	Topic	Methods	Findings
(Shaikh et al., 2023)	Advances in mobile financial services: a review of the literature and future research directions	A three-step structured approach to synthesise 115 most relevant literature	The authors developed and presented a comprehensive framework of Mobile Financial Services (MFSs) and explicitly identified 14 different themes for future research in MFSs.
(Bhag, 2014)	A review of factors affecting digital payments and adoption behaviour for mobile e-wallets	Exploratory research	Security, ease of use, convenience method, and no loss of personal information because scan and payment methods are the key drivers
(Kelly & Palaniappan, 2022)	Factors influencing mobile money transaction service adoption in Ghana, using a Technology Acceptable Model and Diffusion Theory	Exploratory Factor Analysis	The study's findings revealed that perceived risk, perceived cost, and social influence all had repercussions on perceived usefulness and ease of use, influencing users' final decision to use mobile money banking services.
(Adesina & Ayo, 2010)	An Empirical Investigation of the Level of Adoption of Mobile Payment in Nigeria	Quantitative Research	Findings revealed that Convenience, Ease of Use, Ease of Access, and Reduced transaction time drive adoption. Nonetheless, the intricate nature of the interface and processes, the confidence level placed in the service provider and agents (vendors), the

			security and privacy measures used to safeguard genuine information, and the associated costs all contribute to a lack of motivation.
(Ezeh & Nwankwo, 2018)	Factors that Influence the Acceptance of Mobile Money in Nigeria	Quantitative research design	The study extends the applicability of the Technology Acceptance Model (TAM) with other constructs. Findings revealed that perceived usefulness, perceived credibility, perceived expressiveness, and self-efficacy are not necessary for predicting the preferences of Southeast customers to use mobile money.
(Agwu & Carter, 2014)	Mobile Phone Banking In Nigeria: Benefits, Problems, and Prospects	Content Analysis	Findings revealed that the cost and maintenance involved, the education of customers, poverty, and the availability of infrastructure are significant problems for mobile phone banking.
(Luo, Li, Zhang, & Shim, 2010)	Examining multi-dimensional trust and multi-faceted risk in initial acceptance of emerging technologies: An empirical study of mobile banking services	A survey methodology	The findings of this research demonstrate that the perception of risk, which is generated from eight distinct features, has a significant role in influencing the adoption of novel technologies. In addition to existing research, the findings of this study provide empirical evidence in favour of using personal attribute elements to

			analyse the acceptability of mobile banking technology.

Source: (Author's review of literature, 2023)

According to the EFInA (2021) report, the Nigerian digital financial services industry has various payment products and services. However, research has shown that individuals want a more convenient, user-friendly, and affordable means of using mobile technology, namely the USSD technology, to avail themselves of various goods and services (EFInA, 2021). The use of this technology in the context of digital financial services (DFSs) has resulted in a notable expansion of financial inclusion. This has facilitated greater accessibility for people and enterprises to various financially advantageous goods and services, including payments, savings, credit, investment, and insurance (Van-Niekerk & Phaladi, 2021). This study aims to propose a USSD technology adoption framework that would improve the adoption of digital financial services in Nigeria.

While the literature highlighted in Table 2.7 focuses on a generalised mobile banking case research, the study presents a summary of literature relevant to the study at hand to substantiate the relevance of USSD technology-related literature in the context of the Nigeria DFS ecosystem. Some perspectives with their interpretative research aim from the literature are summarised in Table 2.8.

Table 2. 4: Summary of USSD Technology Adoption Literature in Nigeria DFS Ecosystem

Citation	Interpretive Research Aim	Research Focus
(Josephs, 2023)	Improvement in Banking Services using USSD	Quantitative research towards minimizing physical presence at the banking halls during funds deposit using Unstructured Supplementary Service Data
(Bankole et al., 2011)	Improving USSD technology adoption rate	A Study on Mobile Banking Adoption in Nigeria
(Wanuna, 2020)	Improving USSD technology security	Dynamic knowledge-based authentication model for enhancing the security of USSD banking transactions due to its vulnerability as a result of a six-digit PIN transmitted in plain text

(Mogaji et al., 2020)	Adoption Determinants of USSD technology to improve financial inclusion	A systematic literature review of Technologies for Financial Inclusion in Nigeria
(Ezeh & Nwankwo, 2018)	Influencing factors of USSD technology	Empirical analysis of factors influencing the Acceptance of Mobile Money in Nigeria
(Hanouch & Chen, 2015)	Understanding competition intensity within the DFS ecosystem and improving the USSD adoption rate	Qualitative Analysis of Promoting Competition in Mobile Payments: The Role of USSD
(Isiguzo, 2010)	Measuring the impact of mobile technology services in Nigeria, including USSD	A Study on the Impact of Mobile Services in Nigeria
(Bhag, 2014)	Leverage the digitalisation of money and use plastic cards with mobile wallets.	A quantitative review of factors affecting digital payments and adoption behaviour for mobile e-wallets
(David-West et al., 2018)	How innovative technologies such as USSD can improve Digital financial services (DFS)	A resource-based view of digital financial services (DFS): An exploratory study of Nigerian providers
(Yaqub, 2013)	Solving cashless payment challenges using innovative technologies such as USSD	A System Review of The Cashless Policy in Nigeria: Prospects and Challenges
(Wezel and Ree, 2023)	Using innovative technologies incusing USSD technology to improve DFS in Nigeria	A systematic literature review of Improving Financial Inclusion through Digital Financial Services in Nigeria
(Idriss & Ajiya, 2022)	Understanding technology adoption determinants, including USSD, to drive mobile money	A literature review of factors Influencing the Rapid Adoption of Mobile Money in Nigeria and Kenya

Source: (Author's review of literature, 2023)

As indicated in Table 2.8, the study inferred the research aim by reviewing the objectives and findings of the relevant literature highlighted.

2.5.2 Possible Use Cases of USSD in Nigeria's Digital Financial Services Ecosystem

The use of USSD technology in Nigeria has had a substantial impact on the operational efficiency of banks and other suppliers of digital financial services. According to a recent study done in 2021 on Nigerian e-banking consumers, the accessibility of digital banking services using USSD was identified as a significant factor contributing to the efficiency of banks throughout various areas in the nation (Ofure, 2021). Drawing from diverse literature focusing on USSD technology implementation within the DFS ecosystem, four dimensions of USSD technology use cases are presented in this study, as summarised in Table 2.4. These include Self-Service, Financial Services, Information Services, and Marketing and Social Services. To demystify the use case discussed earlier and provide use cases tailored to the study's objective, which predominantly focuses on the DFS in Nigeria, the study suggests elaborate USSD technology use cases to perform digital financial services in Nigeria. Alternate methods to USSD are also indicated, as presented in Table 2.9.

Table 2.9: Possible Use Cases of USSD in Nigeria's DFS Ecosystem

Payment Type	USSD Use Cases	Alternate Payment Methods if USSD is not available
Person-to-Person (P2P)	• Transfers to family/friends • Payment of debt • Gift • Cash withdrawals and deposits • Transfers of funds between own accounts	• Cash • Direct credit transfer • Mobile Money • E-wallet
Person-to-Business (P2B)	• Payments for retail goods (e.g., groceries, food, newspapers, pharmaceuticals, tobacco) • Payments for services (e.g., doctor visits, hairdresser, artisans) • Payments for utilities and other periodic bills (e.g., rent, mortgage, utilities, insurance, Internet, phone, tuition fees, membership fees)	• Cash • Credit/Debit card • Direct Credit transfer • Mobile Money • Direct Debit Transfer • Request to Pay • E-Wallet • Cheque
Business-to-Person (B2P)	• Payments by businesses for raw materials, semi-finished goods, and wholesale products • Payments of salaries, pensions, and social benefits (e.g., private sector payroll, public sector payroll)	• Cash • Direct Credit transfer • Direct Debit Transfer • Request to Pay • Mobile Money

		• Cheque
Business-to-Government (B2G)	• Payments of taxies and levies from businesses to government agencies for procurement of consumable goods (e.g., stationary) and capital goods (e.g., machinery, equipment) • Payment of social security contributions (employer's share, employee's share)	• Cash • Direct Credit transfer • Direct Debit Transfer • Request to Pay • Mobile Money • Cheque
Government-to-Person (G2P)	• Payments of social benefits (e.g., conditional/unconditional social transfers) • Payment of tax refunds (e.g., income and corporate tax refunds)	• Cash • Direct Credit transfer • Mobile Money • Cheque
Person-to-Government (P2G)	• Payment of personal income tax • Payment for government services (e.g., driver's license, travelling passport renewals) • Payment for immigration services	• Cash • Credit/Debit card • Direct Credit transfer • Direct Debit Transfer • Mobile Money • Cheque
Government-to-Government (G2G)	• Payment of social security contributions (employer's share, employee's share)	• Direct Credit transfer • Direct Debit Transfer • Cheque

Source: Author's review of literature in banking and payments (BIS, 2021a; Chaveesuk et al., 2021; Han & Wang, 2021; Iriobe et al., 2021; Lee et al., 2020).

2.5.3 USSD Code Implementation for Digital Financial Services in Nigeria

According to a statement credited to the Central Bank of Nigeria as part of their payment system strategy document release, Nigeria has built a ubiquitous and robust payment service using USSD codes. This has proved extremely popular due to the capability of deploying the solution across mobile devices at a relatively low cost (CBN, 2019). Since 2013, there has been considerable uptake of USSD code implementation and usage for different DFS purposes within the Nigerian banking community. As published on the Central Bank of Nigeria (CBN) website as of 31st December 2022, 30 Banks, 5 Payment Service Banks (PSBs), which are mobile network-led banks, 23 Mobile Network Operators (MNOs), and 45 Payment Service Providers (PSPs) have been licensed to provide digital financial services and operate digital wallets based on a mobile number or unique set of numbers in Nigeria. Out of these licensed institutions, a transaction sampling analysis obtained from the Nigeria Interbank Settlement System Plc (the national switch for digital financial transactions in Nigeria) reveals that only the top 20 banking institutions contribute over ninety-five per cent of DFS-based transactions across Nigeria's economy as shown in Table 2.10.

For this study, we focus on these top banks with their USSD primary code service offering analysis presented in Table 2.8. These services include account opening, interbank transfer, account balance, loan application, airtime purchase, cardless withdrawals, and bill payments, which are the critical USSD use cases that the key DFS players and banks have primarily implemented. These provide a good view of what the features and capabilities of USSD can deliver to motivate adoption. The selection of these use cases also aligns with previous research on DFS in Nigeria, as discussed in section 2.5.2.

Table 2.10: Top 20 Bank's USSD Code Implementation for DFS in Nigeria

S/N	Bank Name	USSD Code
1	Guaranty Trust Bank (GTB)	*737#
2	Access (Diamond) Bank	*901#
3	EcoBank	*326#
4	First Bank	*894#
5	First City Monument Bank (FCMB)	*329#
6	Heritage Bank	*322#
7	Keystone Bank	*7111#
8	Stanbic IBTC Bank	*909#
9	Sterling Bank	*822#
10	United Bank for Africa (UBA)	*919#
11	Wema Bank	*945#
12	Zenith Bank	*966#
13	Fidelity Bank	*770#
14	JAIZ Bank	*773#
15	Polaris Bank	*833#
16	Union Bank	*826#
17	Unity Bank	*7799#
18	Standard Chartered Bank	*977#
19	Titan Trust Bank	*922#
20	Taj Bank	*898#

Source: Researcher (Online Survey as of December 2022)

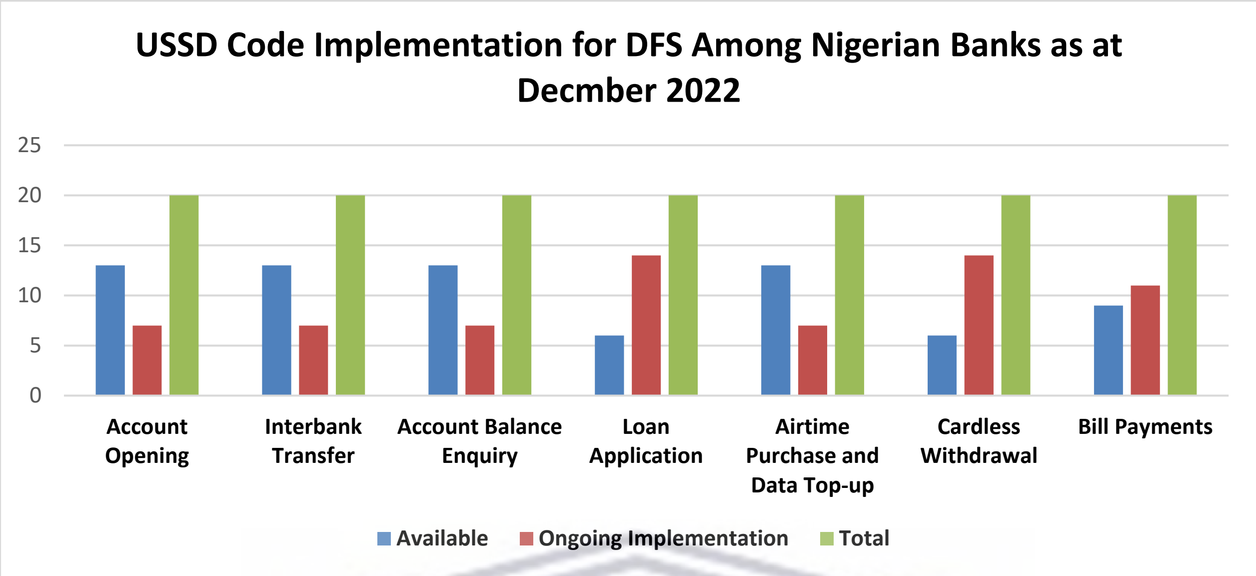


Figure 2.6: Top USSD Code Implementation for DFS among Nigerian Banks

As shown in Figure 2.6, approximately seventy per cent of banks reviewed have implemented USSD code for account opening, interbank transfer, account balance inquiry, and airtime purchase. Over 40% have implemented bill payments, while approximately 20% have implemented loan applications and cardless withdrawals. Implementing USSD for other DFS use cases is a work in progress. The outcome of the framework developed for this study will complement the efforts of these stakeholders to improve USSD technology adoption decisions for DFS in Nigeria. To provide a theoretical understanding of the study's objectives, reviewing relevant theories broadly applicable to technology innovation adoption is imperative. The following section will discuss the Technology Acceptance Model, one of the theories underpinning this study's proposed USSD technology adoption framework. As more use cases of USSD technology continue to be rolled out within Nigeria's digital financial services ecosystem, the literature suggests a continuous evaluation of their impact on the performance of digital financial service offerings, customer satisfaction, and investment returns (Hines, 2018).

Ozili (2023) also opined that digital technology investments to accelerate financial services are worth a review based on the growing investments to implement an unparalleled combination of the new retail payment innovations entering the banking industry. After thoroughly examining and discussing existing literature on mobile technology innovation, evolution, and the application of USSD technology in the DFS ecosystem in Nigeria, the following section will discuss theories that form the foundation of the proposed USSD technology adoption framework for this research. In addition to the theories examined in this study, other theories within the Information Systems (IS) research are pertinent to investigating technological innovation and adoption. These theories will also be discussed in the following section.

2.6 Technology Acceptance Model (TAM)

Numerous scholars have discussed and featured TAM in relevant studies to explain users' intention to adopt and use technology. TAM, one of the prominent theories in IS research initially proposed by Davis in 1989, has been extensively used to describe how users accept and use a specific technology (Sadeck, 2022). Lai (2017) posits that the persistent evolution of technology poses a dual challenge to both novel and established business models while concurrently presenting prospects for enhancing service provisioning. Organizations are required to continuously adjust to the evolving landscape of technology and understand the pace at which customers embrace new technologies, taking into account the implications of convenience, consumer wants, security, and other related factors that arise from the adoption of these new technologies (Venkatesh, Davis, & Morris, 2007). In light of these ongoing fluctuations, it is crucial for organisations to consistently assess the factors that influence the adoption of technology (Lai, 2017).

Resistance to technological innovation can arise from various factors, including the inherent characteristics of the innovations themselves and conflicts with existing beliefs and psychological barriers. Previous research has demonstrated that the Technology Acceptance Model (TAM) offers a foundational framework for comprehending the adoption of technology and the resistance to innovation (Kaur, Dhir, Singh, Sahu, & Almotairi, 2020). Similarly, Granić (2023) argued that TAM had become a foundation for studying consumers' behavioural intentions beyond individual technology adoption discussions. Venkatesh et al. (2007) realised the obsolesce and applicability of previous technology adoption theories before TAM in general society. They also examined the evolution of the broader domain of technology adoption research, and evidence from their study suggests the extension of TAM into a more comprehensive perspective suitable to the research agenda.

This also corroborates with Granić (2023) and Sadeck (2022), who opined that research strategy, problem statements, events, and study conditions are the determining factors of using TAM under single research. These suggestions also align with the views of Lai (2017), who suggests TAM has been expanded over the years by several researchers and has been applied to many novel technology adoption investigations that require users' and behavioural resistance toward innovations (Kaur et al., 2020) and technology innovation adoption response, including the adoption of USSD technology (Lai, 2017). To complement the proposed USSD technology adoption framework for this study, extending TAM as one of the foundational theories, different scholars have also identified the suitability of TAM in investigating technology adoption for digital financial services. For instance, in the study of mobile banking adoption in Nigeria, Bankole et al. (2011) extended TAM and integrated theory of reasoned action (TRA), the theory of planned behaviour, and the unified theory of use and acceptance of technology (UTAUT) to determine factors affecting users' behavioural intention. Some factors considered include performance expectancy (e.g., perceived usefulness), effort expectancy (e.g., perceived ease of use), social influence, and facilitating conditions.

Given the increasing use of and demand for smartphones and mobile banking, related research examining the adoption of these new technologies also proposed an integrated approach beyond TAM (Shaikh et al., 2023). Furthermore, to enhance the scope of the Technology Acceptance Model (TAM) in examining the growing prevalence of mobile devices and the utilization of mobile technologies for financial transactions, Kaur et al.(2020) integrated TAM with innovation resistance theory (IRT). This integration aimed to explore the psychological and functional obstacles that hinder the adoption of technological innovations. Similarly, Bhag (2014) developed an integrated framework using TAM and UTAUT to determine the adoption of new technologies, such as USSD technology and QR codes for digital payments and mobile e-wallets in rural India.

Also, in examining multi-dimensional trust and multi-faceted risk in the initial acceptance of emerging technologies for mobile banking services, scholars (Luo et al., 2010) adopted constructs of the Theory of Planned Behavior (TPB), the Technology Acceptance Model (TAM) to empirically investigate a developed framework related to USSD and mobile banking services. The first version of TAM, as proposed by Venkatesh et al. (2007), is depicted in Figure 2.7.

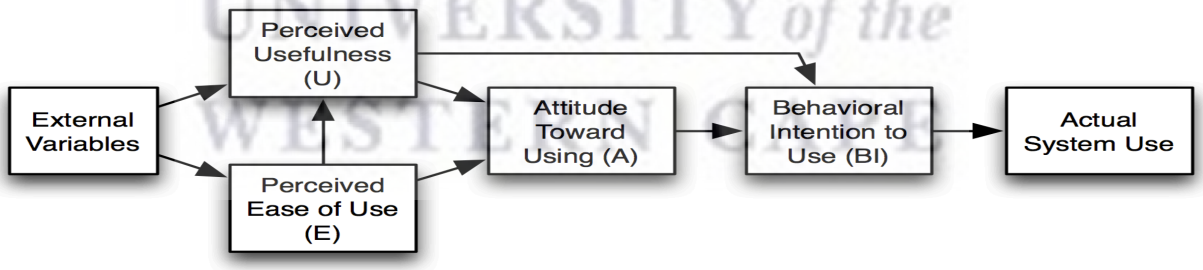
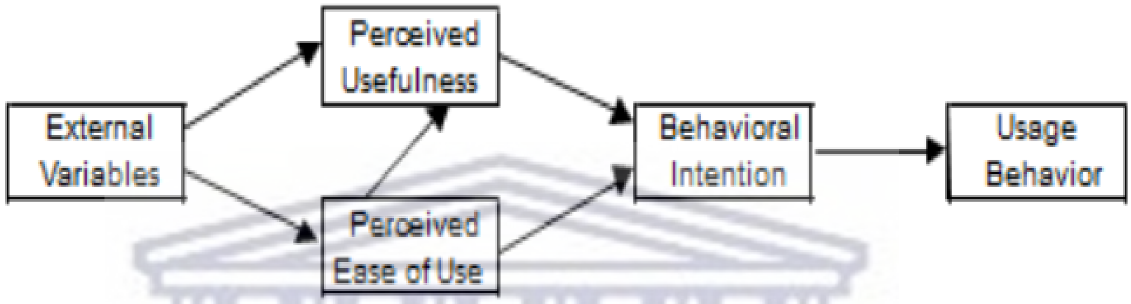


Figure 2.7: First version of the Technology Acceptance Model (TAM)

A Technology Acceptable Model (TAM) integrated with Diffusion Theory has also been used to investigate factors influencing mobile money transaction service adoption in Ghana. The research, conducted on 2,298 mobile money users spread across Ghana's sixteen (16) regions, proposed an integration of construct used in both the Diffusion Theory (DT) and the Technology Acceptable Model (TAM) (Kelly & Palaniappan, 2022). As discussed earlier, the original TAM (TAM1) proposed by Davis in 1989, as shown in Figure 2.8, has been modified in various IS research activities. To enrich the research agenda, scholars have extended the original TAM by adding external variables in the original model to incorporate the factors of users' attitudes, behavioural intention, actual use of technology, and quite a few factors enrich the research agenda (Venkatesh, Brown, and Sullivan 2016). In the critique of TAM1, Venkatesh et al. 2007 discovered the need to merge perceived usefulness and ease of use since both were found to influence behavioural intention directly, thus eliminating the need for the attitude construct (Venkatesh et al., 2007). TAM2, as shown in Figure 2.8, is an improvement of TAM1 (Venkatesh et al., 2007).



(Venkatesh et al., 2007)

Figure 2.8: Revised Technology Acceptance Model (TAM2)

To validate the efficacy of TAM2, Venkatesh et al. (2007) further theorised mental assessment of the match between important goals at work and the consequences of performing job tasks. Evidence from the results revealed that TAM 2 performed well in both voluntary and mandatory environments. In evaluating TAM efficacy in consumer preparedness for mobile payment technology adoption, TAM has been widely used in academic research to investigate the factors influencing consumer acceptance of these technologies (Shailza & Sarkar, 2019). According to Kelly & Palaniappan (2022), the overall attributes and characteristics of perceived utility and simplicity of use have been identified as significant determinants that positively influence customers' attitudes to adopt new technology. This also aligns with the views of Shailza & Sarkar (2019) and Sadeck (2022), who opined that compatibility, simplicity, degree of awareness, mobility, trust, and security influence consumers' technology adoption intentions.

Despite the widespread adoption and frequent use of TAM in IS research, scholars (Kaur et al., 2020) further argued that TAM had been widely criticised because the theoretical constructs lack of focus on user perception and limited explanatory and predictive power on behavioural intentions, triviality, and lack of practical value (Granić, 2023). Sadeck (2022) also opined that the Technology Acceptance Model (TAM) presents a particular perspective on the perception and acceptance of technology while obscuring other viewpoints. Sadeck (2022) further asserts that the Technology Acceptance Model (TAM) has resulted in notable gaps in our understanding and is also constrained in its inquiry of research gaps, specifically regarding the factors that prompt people to adopt a technology. In general, TAM focuses on the individual 'user,' with the concept of 'perceived usefulness,' with extension to bring in more and more factors to explain how a user 'perceives' 'usefulness,' and ignores the essentially social processes of IS development and implementation, without question where more technology is better, and the social consequences of IS use (Ezeh & Nwankwo, 2018).

Despite the criticism of TAM, Bankole et al. (2011) suggest that the applicability of TAM2 constructs aligns with the view of previous IS research due to its component of behavioural intentions. However, due to the subjectivity of perceived ease of use, TAM 3 was developed by incorporating four variables: individual differences, system characteristics, social influence, and facilitating conditions, which are determinants of perceived usefulness and perceived ease of use (Adesina & Ayo, 2010). According to Lai (2017), the TAM3 research model supports real-world settings of IT implementations. Constructs of TAM1, TAM2, and TAM3 (perceived usefulness and system characteristics) are part of the constructs for the proposed framework for the study. For these reasons, adopting TAM is considered suitable as one of the models incorporated in the study to examine factors to improve USSD technology adoption for digital financial services. The following section discusses Stimulus Organism Theory.

2.7 Stimulus Organism Theory

Lai (2017) presented the stimulus organism theory as a means to address the limitations of the Technology Acceptance Model (TAM) in including user behavioural intents and the crucial determinants of technology adoption, such as the features and capabilities of the technology. According to Lai (2017), technology adoption challenges necessitating combining the technology's features and capabilities and the adopter's motivation to use that technology are too complex to be solved with a single approach, as there is no one-size-fits-all solution to the problem situations. In extending TAM, Lai (2017) developed the Stimulus Theoretical Framework based on Stimulus-Organism Theory (Figure 2.9). The framework incorporates the User Experience Design and Security constructs as external variables and original constructs of perceived usefulness and perceived ease of use, which are part of TAM (Lai, 2017).

These provide additional lenses for the study to investigate the impact of USSD technology features and capabilities on consumers' behavioural decisions to adopt USSD technology and use the technology to perform digital financial services. (Granić, 2023; Lai, 2017; Sadeck, 2022)

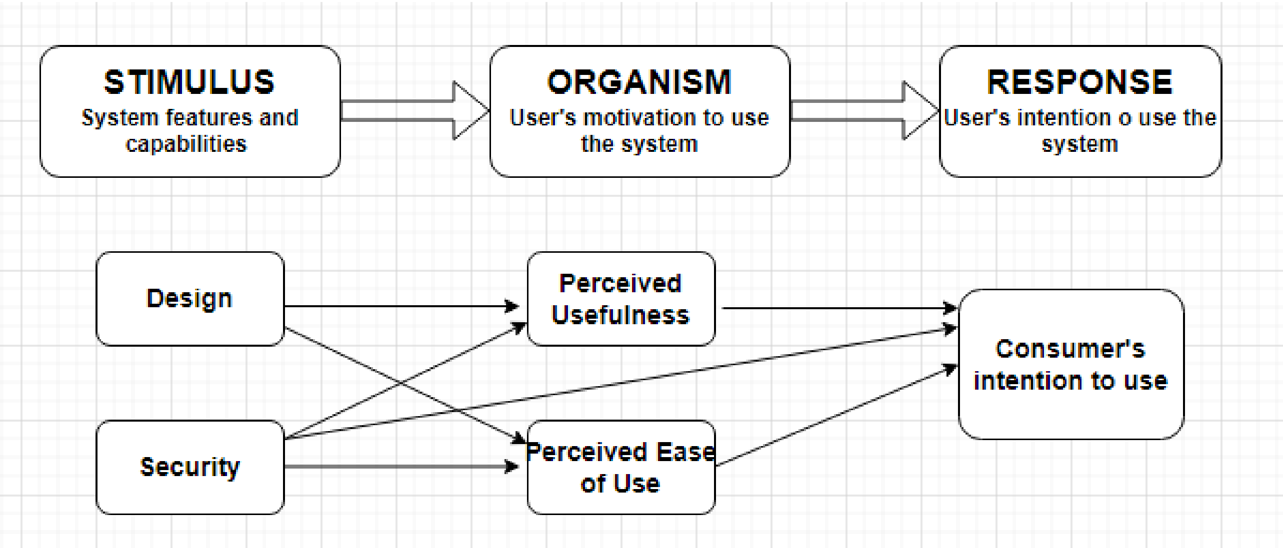


Figure 2.9. Stimulus Theoretical Framework (Lai, 2017)

Several previous review studies were conducted to understand the suitability of the technology acceptance model (TAM) in the context of mobile financial services (MFS) by evaluating various factors (Gbongli, Xu, & Amedjonekou, 2019). Although each of these studies provides a helpful summary of the Technology Acceptance Model (TAM), additional unresolved concerns have been identified, highlighting the need for more studies focusing on the technology features and capabilities (Gbongli, 2022). According to Lai (2017), researchers have used TAM, TAM2, TAM3, and UTAUT over the years to explain the adoption of electronic payment systems and technologies. The decision to adopt TAM as the underlying framework to develop a stimulus theoretical framework for the novel technology of a single platform E-payment System was predicated on the fact that there is a lack of empirical investigations combining the factors of the three e-payment channels (Card, Internet, and Mobile) in one study.

Lai (2017) further proposed a unified approach encompassing different views and interpretations with other technology adoption models and theory variables to derive a stimulus theoretical framework. As shown in Figure 2.8, while the design and security are the stimulus of the system (features and capabilities of USSD technology), the perceived ease of use and perceived usefulness are the organism (motivators to use USSD technology for digital financial services) the system that leads to consumers' respond to use the system (Lai, 2017). Lincoln (2005) argued that in designing a USSD technology adoption framework for digital financial services, constructs of the framework (security and design) of USSD technology are critical components of the research. This is in tandem with this study's view on USSD security, as discussed in section 2.3.3. Lincoln (2005) and Gbongli (2022) further suggest validating the stimulus theory provided the technological conditions' quality criteria, validity, and reliability are considered.

2.8. Information System Success Theory

The theory of information systems (IS) success, also known as the IS success model or the Delone and McLean IS success model, offers a comprehensive framework for comprehending the success of IS. In current scholarly investigations, the concept of Information System (IS) success has emerged as a highly debated and significant dependent subject of IS (Rabaa'i, 2009). It achieves this by identifying, describing, and explaining the interrelationships among six key dimensions commonly used to evaluate information systems (Al-Kofahi, Hassan, & Mohamad, 2020). Researchers have derived several models to explain what makes some information systems (IS) successful. Although much research supports the TAM as an excellent model to explain technology acceptance (Venkatesh et al., 2007), acceptance is not equivalent to success (Adesina & Ayo, 2010). According to Rabaa'I (2009), accepting an information system is a necessary precondition to success, and early attempts to define information system success were ill-defined due to IS success's complex, interdependent, and multi-dimensional nature (Petter, DeLone, & McLean, 2008).

To address this problem, DeLone & McLean (1992) reviewed the research published from 1981–1987 and created a taxonomy of IS success by defining six variables of the IS success model. These variables are system quality, information quality, use, user satisfaction, individual impact, and organizational impact. However, these six variables are not independent success measures but interdependent (Al-Kofahi et al., 2020). As shown in Figure 2.10, the original IS success model consists of six constructs.

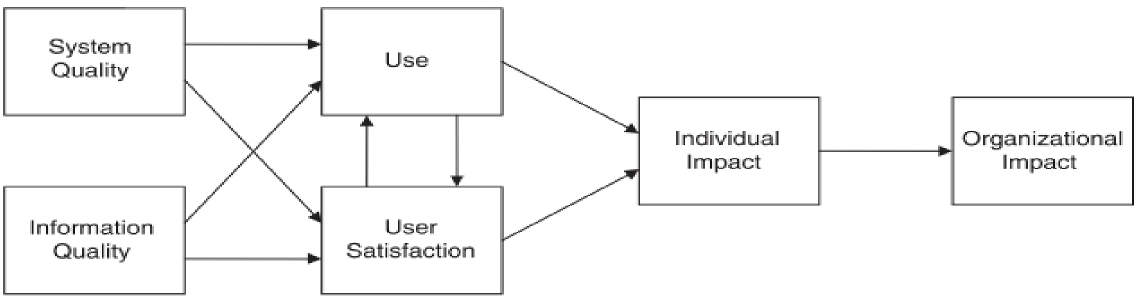


Figure 2.10: Delone and McLean IS Success Model (1992)

Gable et al. (cited by Rabaa'I, 2009) developed an IS impact model from the original IS model developed by DeLone and McLean (1992). The motivation for this research originates from the absence of a dependable, uniform, and empirically verified measuring framework for evaluating the effectiveness or influence of modern information systems (Rabaa'i, 2009). The IS-Impact paradigm, according to Rabaa'I (2009), has four fundamental characteristics, namely, Information Quality (IQ), System Quality (SQ), Individual Impact (II), and Organizational Impact (OI). With the continued augment of IS success possibility to derive impact, Rabaa'I (2009) further systematically analyzed the similarities of DeLone & McLean's (1992) IS model and models of IS-impact success in the Australian Universities context. Since the inception of the first IS success model, there has been a discourse around the concept of success, along with subsequent expansions and examinations of such a model, particularly concerning the advantages derived from information systems and the fast evolution of technology (DeLone & McLean, 2002).

Al-Rahmi et al.(2021) argued that the IS success model by DeLone & McLean (1992) should be integrated with other IS theories to cope with rapid technological changes and improve specificity and explanatory power. This also aligns with the views of Adesina & Ayo (2010), who suggest that variables of the initial IS success model (i.e., system quality, information quality, use, and user satisfaction) should be modified to reflect business benefits and impact. In Petter et al. (2008), the original IS success model's constructs were changed to reflect the system's usefulness and to reflect it as a better measure of IS success than use (Petter et al., 2008). Following the criticism of the original IS success model by DeLone & McLean (1992) and borrowing from the SERVQUAL model, the service quality of derived technology use was incorporated into the original IS success model (DeLone & McLean, 2002).

This allows for measuring and comparing user expectations and user perceptions of the technology (Al-Rahmi et al., 2021). The improved IS Success model is depicted in Figure 2.11. Recent empirical studies related to IS success models on individual and organisational impact have adopted this updated IS success model (Lutfi et al., 2022).

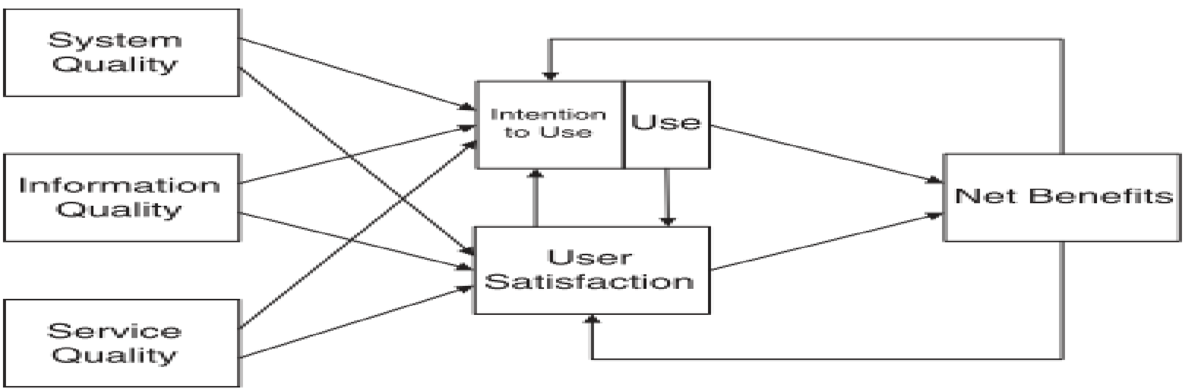


Figure 2.11: Updated Delone and McLean IS Success Model (2003)

Due to the ongoing proliferation of overlapping measures in IS success, which is one of the essential gaps to be addressed by the updated Delone and McLean IS success model shown in Figure 2.11. Rabaa'I (2009) concurs that the revised Delone and McLean Information Systems (IS) success model is beneficial in addressing duplication and creating new metrics for modern IS. The revised model addresses the ongoing ambiguity surrounding the DeLone and McLean constructs, specifically regarding their classification as measures or explanandum. This conceptual clarification highlights the significance of these constructs and provides a compelling justification for considering User Satisfaction as both a consequence and antecedent of success rather than merely a construct (Al-Rahmi et al., 2021). The development of the proposed framework for adopting USSD technology in this study incorporates constructs from the improved IS Success model.

These constructs offer empirical evidence of the advantages of successfully implementing USSD technology. Consequently, they are expected to impact users' intention to utilise USSD technology to realize its benefits. The following section will discuss other IS theories adopted in various IS literature to develop frameworks or models for technology adoption and usage discussions.

2.9 Review of Relevant IS Theories

As mentioned, many theories focus on adopting technology in information systems (IS) research. These theoretical frameworks might be used in a research study to fill the gaps in the current literature and accomplish the intended research objectives. The scholarly literature has underscored the need for a multi-disciplinary strategy using several theoretical frameworks. (Hidayat-Ur-Rehman et al., 2021). With the combination of IS theories adopted to propose a USSD technology adoption framework for this study, as discussed in section 2.8, other relevant IS theories relevant to the research objectives but not incorporated in the proposed USSD technology adoption framework for the analysis are briefly discussed.

2.9.1 The Theory of Reasonable Action

The Technology Acceptance Model (TAM) is recognized as an extension and use of two psychological theories. The two theories under discussion are the Theory of Reasoned Action (TRA), proposed by Fishbein and Ajzen in 1975, and the Theory of Planned Behavior (Sadeck, 2022). TRA determines the behavioural intention of the person's attitudes toward that behaviour. The contextual problem driving this theoretical study is understanding consumers' intention to adopt USSD technology to perform digital financial services in Nigeria. Gbongli et al. (2019) provide academic validation of TRA adoption to analyse the drivers of mobile financial services adoption and some theoretical models. Considering the subjectivity of human reasoning, which can also be likened to attitude, a second factor is required to analyse the subjective norms of what they perceive as their immediate attitude to a specific behaviour (Sadeck, 2022). TRA, as defined by Fishbein & Ajzen in 1975 (cited by Lai, 2017), is shown in Figure 2.12.

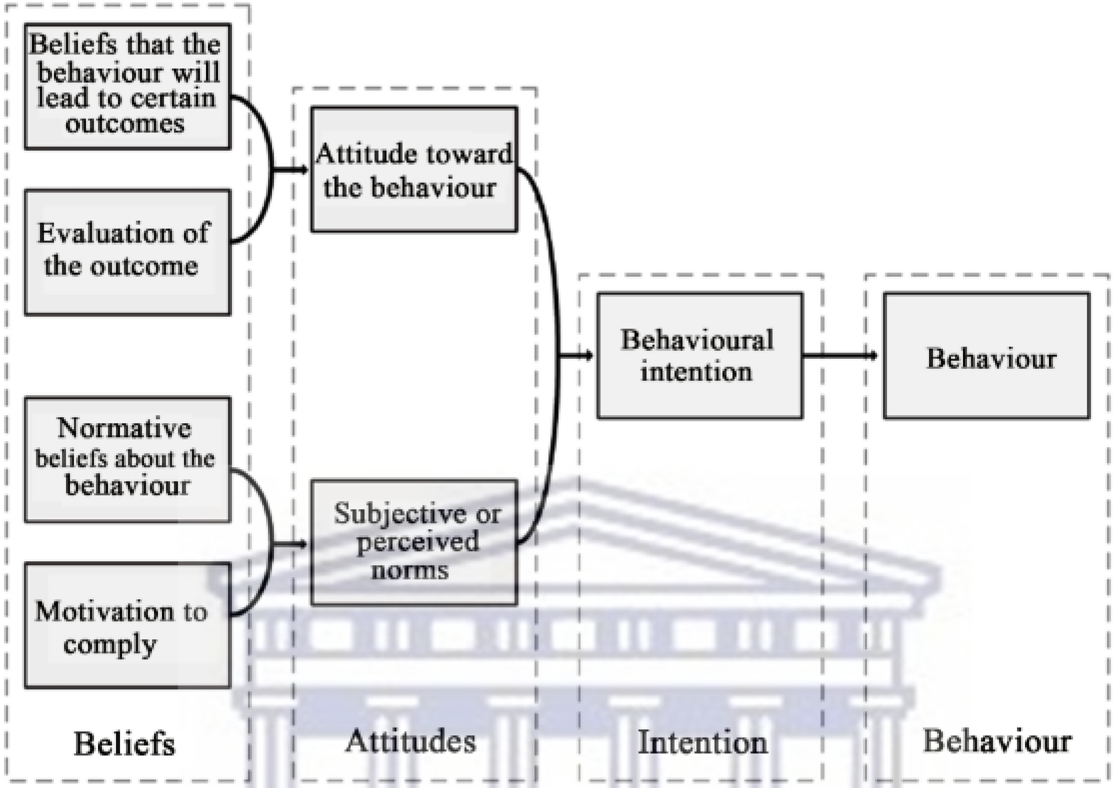


Figure 2.12: Revised The Theory of Reasonable Action by Fishbein & Ajzen of 1975 (Lai, 2017)

2.9.2 Technology-Organisation-Environment (TOE) Framework

Contemporary organisations are now embarking on the process of digital transformation. Organizations have significant difficulties maintaining their viability within the global market, presenting managers with the formidable task of achieving sustainable development. Digital transformation has significantly impacted numerous socio-economic sectors, prompting businesses to adopt digital technologies to drive operational efficiencies and profitability within their operations (Nguyen, Le, & Vu, 2022). With this realisation, the Technological Organizational and Environmental (TOE) Framework is often used as a prominent framework to analyse and determine technological adoption options available to organisations to achieve their strategic objectives (Sayginer & Ercan, 2020). As the Fourth Industrial Revolution (4IR) continues to evolve with new technologies such as artificial intelligence (AI), Distributed Ledger Technology (DLT), and Interactive Voice Recognition (IVR) technologies continue to be the core of modern businesses, Na et al. (2022) suggest a combination of technology acceptance model (TAM) and technology–organisation–environment (TOE) framework is required to enrich adoption decisions.

Previous studies adopted the TOE framework (as shown in Figure 2.13) to match the characteristics of technology and those of the organization's internal and external environment to explain the use of new technology (Justino, Tengeh, & Twum-Darko, 2022). In dealing with these business and environmental complexities, the TOE framework has been widely used as a fundamental theory in different fields, including Information Systems Research (Justino et al., 2022).

The environmental context: The TOE framework's environmental context reflects the business environment's external characteristics that account for the innovation's use. It defends the idea that the environment in which the entrepreneur conducts business would determine their technology adoption decision. Adopting technology is associated with certain combinations of environmental characteristics that would play a part in the technology integration process (Justino et al., 2022; Nguyen et al., 2022).

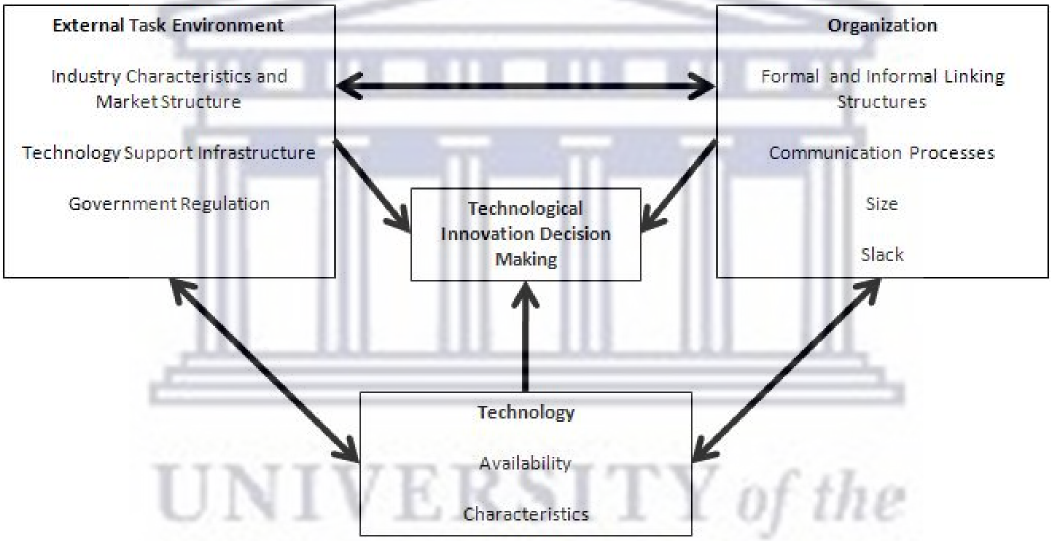


Figure 2.13: The TOE Framework (Nguyen et al., 2022)

Organisational context: the organisational context considers the characteristics of the firm and its resources, including the quality of the employees' technology usage expertise, managerial structure, and amount of resource slack, including the firm's size (Justino et al., 2022; Nguyen et al., 2022).

Technological context: TOE suggests that a business should consider the characteristics of its internal and external technological structure (Justino et al., 2022; Nguyen et al., 2022). This implies taking cognisance of this important technology the business already has and is available in the external environment before adopting and using new technology.

2.9.3 Diffusion of Innovations (DoI) Theory

DoI theory has been widely used in social science from a broad perspective (Dearing & Cox, 2018). This theory, developed by Rogers in 1962, has brought many contributions to other researchers, especially in innovation diffusion. According to scholars in IS research, diffusion of innovation (as shown in Figure 2.14) is a social process that occurs among people in response to learning and belief in adopting technological innovations such as USSD technology (Faisal & Idris, 2020).

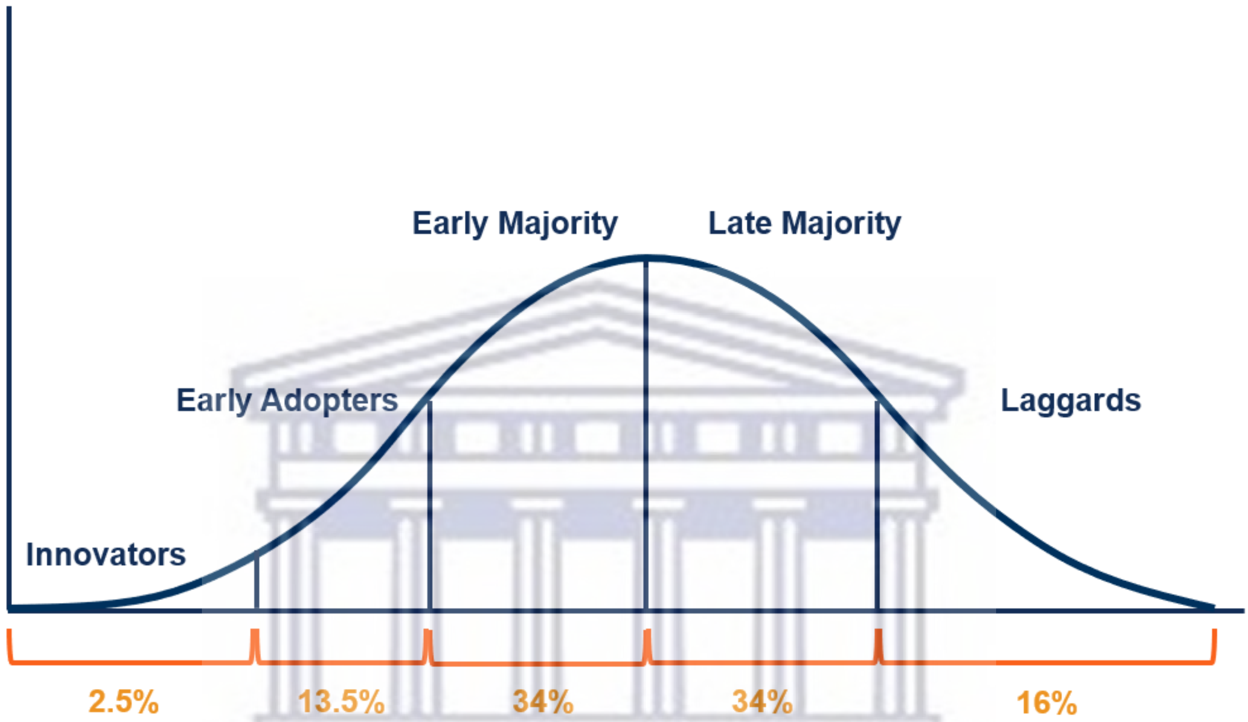


Figure 2.14: The Diffusion of Innovations (Dearing & Cox, 2018).

In Faisal & Idris (2020), DoI theory focuses on the belief technology perspective and describes a five-step process or stages in technology adoption: knowledge, persuasion, decision, implementation, and confirmation. These stages, also called communication channels, would be passed by individuals or organisations at a different rate of innovation usage, depending on adopters' characteristics, including innovators, early adopters, late adopters, late majority, and laggard (Dwivedi, Wade, & Schneberger, 2012; Faisal & Idris, 2020). According to Dearing & Cox (2018), diffusion of innovation is determined by the characteristics of adopters, especially potential adopters' perceptions of opinion leaders' reactions or social influence, and the larger social and political context, including the salience of issues related to the innovation.

2.9.4 Unified Theory of Acceptance and Use of Technology (UTAUT)

Since its inception, the Unified Theory of Acceptance and Use of Technology (UTAUT) has been extensively used in technology adoption and diffusion research. Researchers performing empirical studies on user intention and behaviour have often embraced UTAUT as a theoretical framework (Williams, Rana, & Dwivedi, 2015). Venkatesh et al. initially formulated The theory under consideration (as cited in Williams et al., 2015). It was developed by synthesising and analysing eight prominent theories and models, namely the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), the Motivational Model, the Theory of Planned Behaviour (TPB), a combined TBP/TAM, the Model of PC Utilization, Innovation Diffusion Theory (IDT), and Social Cognitive Theory (SCT) (Williams et al., 2015). AlQudah (2015) asserts that the application of the Unified Theory of Acceptance and Use of Technology (UTAUT) in diverse Information Systems (IS) studies has yielded several additions to the existing body of literature. This study offers an empirical analysis of technological adoption by examining and contrasting many significant ideas in the field. These theories typically provide differing or limited viewpoints on the topic. UTAUT offers more substantial predictive power than the rest of the models examining technology acceptance (AlQudah, 2015).

As shown in Figure 2.15, the theoretical model of UTAUT suggests that the actual use of technology is determined by behavioural intention. The perceived likelihood of adopting the technology depends on the direct effect of four fundamental constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. The impact of predictors is moderated by age, gender, experience, and voluntariness of use (Marikyan & Papagiannidis, 2021). Since its inception, the Unified Theory of Acceptance and Use of Technology (UTAUT) has been extensively used in technology adoption and dissemination research. It is a theoretical framework for researchers who perform empirical studies on user intention and behaviour (Williams et al., 2015).

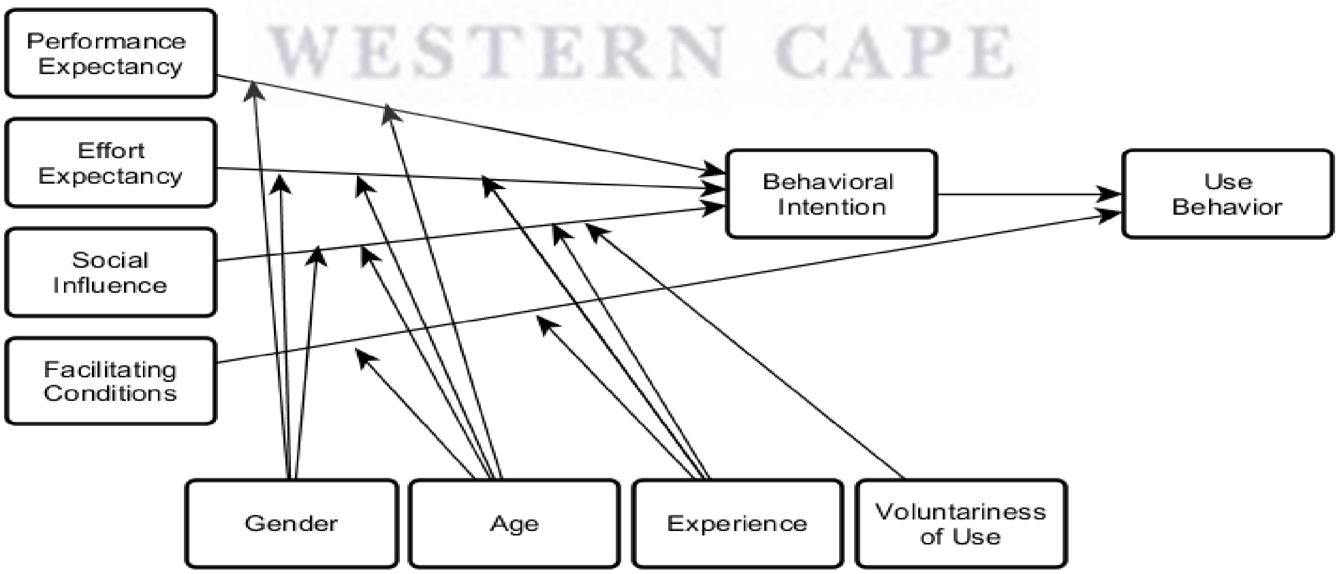


Figure 2.15: Unified Theory of Acceptance and Use of Technology (Williams et al., 2015)

Although the original UTAUT framework was developed to explain and predict technology acceptance in an organisational context (Marikyan & Papagiannidis, 2021), UTAUT showed wide application, enhancing the theory's generalisability (Hidayat-Ur-Rehman et al., 2021). Given the variance of information communication technologies and the advances in the sector, several scholars extended UTAUT to adapt it to the context or improve its predictive power for technology adoption (Momani, 2020).

2.9.5 Systematic Theoretical Analysis

A study with multiple internal and external complexities in IS research requires a no one-fit size approach for the research phenomenon. This must ensure that relevant theories and constructs address the research objectives. In developing a framework for USSD technology adoption, the researcher adopted TAM, IS Success theory, and the stimulus Theoretical Framework. Table 2.11 presents a summary of the theories reviewed in this section. This is based on the review of this study.

Table 2. 5: Summary of Evaluation of Suggested Theories

S/N	Related Theories	Strength(s)	Weakness(s)
1	**TECHNOLOGY ACCEPTANCE MODEL (TAM)**	• TAM provides a superior and highly accurate predicting capability for technology acceptance (Rad et al., 2022) • TAM is simple to comprehend due to its small number of components and has demonstrated a high degree of predictiveness in a variety of scenarios with consideration for internal and external factors (Folkinshteyn & Lennon, 2016) • The Technology Acceptance Model (TAM) is a reliable and effective model used to predict user acceptance of information technologies. It has been extensively studied and has consistently demonstrated its ability to explain a significant	• TAM fails to account for several crucial theoretical factors when considering internal and external complexities (Siti et al., 2021) • TAM disregards the many user task options and the constraints they impose (Lai, 2017)

		portion of the variability in usage intentions and behaviours across various information technologies. TAM is considered a robust and parsimonious model, offering valuable insights into user acceptance. (Singh & Srivastava, 2019)	
2	**THEORY OF REASONABLE ACTION (TRA)**	• The TRA model has a high potential for predicting customer behaviour regarding various consumer goods. This is shown by the model's ability to predict the chance of people buying certain goods (HALE, HOUSEHOLDER, & GREENE, 2012) • The theory of Reasonable Action (TRA) is a well-researched idea created to explain almost all human conduct.	• It is difficult to disentangle the direct impact of subjective standards on behavioural intention from the indirect effect of attitudes since this hypothesis does not have complete control over consumer behaviour in certain instances (Farhi, Jeljeli, Zahra, Saidani, & Feguiri, 2023) • The TRA model does not take into account personality characteristics, demographic factors, or social positions as predictors of behaviour (Isa, Ahmad, & Prachaseree, 2022)
3	**UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY (UTAUT)**	• The Unified Theory of Acceptance and Use of Technology, or UTAUT, has more explanatory power than any standard acceptance model. Consequently, it aids the technology development process. This is owing to the many factors	• The Unified Theory of Acceptance and Use of Technology (UTAUT) paradigm may not be appropriate for supporting sensitive and secret research that might encourage the collection of

		that it considers (Marikyan, D. & Papagiannidis, 2021) ● The fact that demographic and experience characteristics have been included in the UTAUT model is the fundamental advantage of using it. So, it is more suited for product or service-related research in the business-to-consumer market (Maqbool Ahmad, 2018)	trivial and complex data (Qiao, Zhu, Guo, Sun, & Qin, 2021). ● The UTAUT model disregards cultural considerations, although these considerations may be relevant in the majority of nation-states and countries (Momani, 2020)
4	**Stimulus Theoretical Framework- the S-O-R model**	• The theory's attempt to go further than the outer layer of technology to consider the internal mechanisms that motivate the use of such technology is one of the reasons for its adoption in this study. • The S-O-R model "provides a structural manner to explore the impact of interpersonal interaction factors and customer experiences on purchase intention" (Liu et al., 2018, p. 3). These interpersonal interactions and customer experiences often form strong environmental stimuli, motivating the behaviour of a potential user of a given technology.	• Environments that stimulate the internal motivation to adopt technology are hardly homogenous. Thus, the S-O-R as a framework for studying digital finance adoption may produce results in other economies that vary from those conducted in Nigeria.
5	**TECHNOLOGY-ORGANIZATIO N-**	● The Technology-Organization-Environment (TOE) hypothesis helps study the adoption of new types of information technology	● Technology-Organization-Environment (TOE) has a problem in that it assumes the model would be

	ENVIRONMENT (TOE)	since it accounts for the aspects that affect its acceptability and use (Nguyen et al., 2022). ● The TOE Framework identifies elements of the organisational environment that influence the adoption and implementation of technological innovations. These factors may have a substantial effect on the adoption and implementation process's performance (Justino et al., 2022)	relevant to large companies, as opposed to small and medium-sized firms (SMEs), where customers are more confident of consistency and have fewer complaints (Justino et al., 2022)
6	**THE INFORMATION SYSTEM SUCCESS MODEL**	● IS success model can be used to classify the numerous different information system success metrics employed in the research literature and ultimately analyse the effectiveness of such in information systems. (DeLone & McLean, 2002) ● System and information quality are the primary variables impacting user interest and satisfaction (Rabaa'I, 2009). The information system success model is thus used to analyze the effectiveness of such in information systems.	● Although acceptance of an information system is a necessary precondition to success, the IS success model presents a misrepresentation of success as not equivalent to success (Adesina & Ayo, 2010). ● The inability to adapt the constructs to external complexities and behavioural decisions makes it challenging to use (Al-Kofahi et al., 2020)
7	**DIFFUSION OF INNOVATION THEORY (DIT)**	● The diffusion of innovation hypothesis explains the rate at which consumers will accept new products or services. Hence, the model helps businesses determine the likelihood that	● The model does not take into account a person's financial situation or social support when recommending a new

		their new product will succeed or fail and helps marketers understand how trends form (Sayginer & Ercan, 2020) ● Flexible for use across multiple sectors, including marketing, public relations, social work, agriculture, and public health (Faisal & Idris, 2020) ● DoI theory works best when new behaviors are adopted rather than when new behaviors are avoided or stopped(Dearing & Cox, 2018).	behaviour or innovation (Faisal & Idris, 2020) ● The notion of innovation dissemination is usually oversimplified to just focus on a particular innovation or product, omitting the nuanced social, cultural, economic, and other factors that influence how the invention is adopted by society(Dearing & Cox, 2018). ● The model focuses on a few key innovations and, therefore, can prevent diffusion research from progressing and producing meaningful results on a more extensive idea(Sayginer & Ercan, 2020).

2.10. Chapter Summary

The chapter adopted a multi-disciplinary approach to review extant literature to comprehensively understand the study's aim and objective. This chapter has provided a comprehensive review of mobile technology evolution from 1G to 5G, with various improvements and projections for the next generation of 6G. Also discussed in this chapter is USSD technology applicability to perform digital financial services, including features and capabilities and various use cases in Nigeria. USSD technology has improved access to digital financial services and is rapidly becoming ubiquitous to increase the financial inclusion rate in Nigeria. The chapter further summarises USSD code implementations among the top 20 banks in Nigeria. This chapter also discussed and summarised previous studies on USSD technology adoption.

In addition, the three main theories that underpin the proposed USSD technology adoption framework, the Technology Acceptance Model (TAM), Information System (IS) Success Theory, and Stimuls-Orgnism Theory, were discussed in this chapter. The literature review presented the rationale for adopting these theories to propose a USSD technology adoption framework. Other relevant IS theories with potential considerations for future investigation of the outcome of this study were also discussed in this chapter. The next chapter will discuss the proposed USSD technology adoption framework, the constructs of the framework, and the hypothesis to be used for the study.

CHAPTER 3- DIAGRAMMATIC OVERVIEW

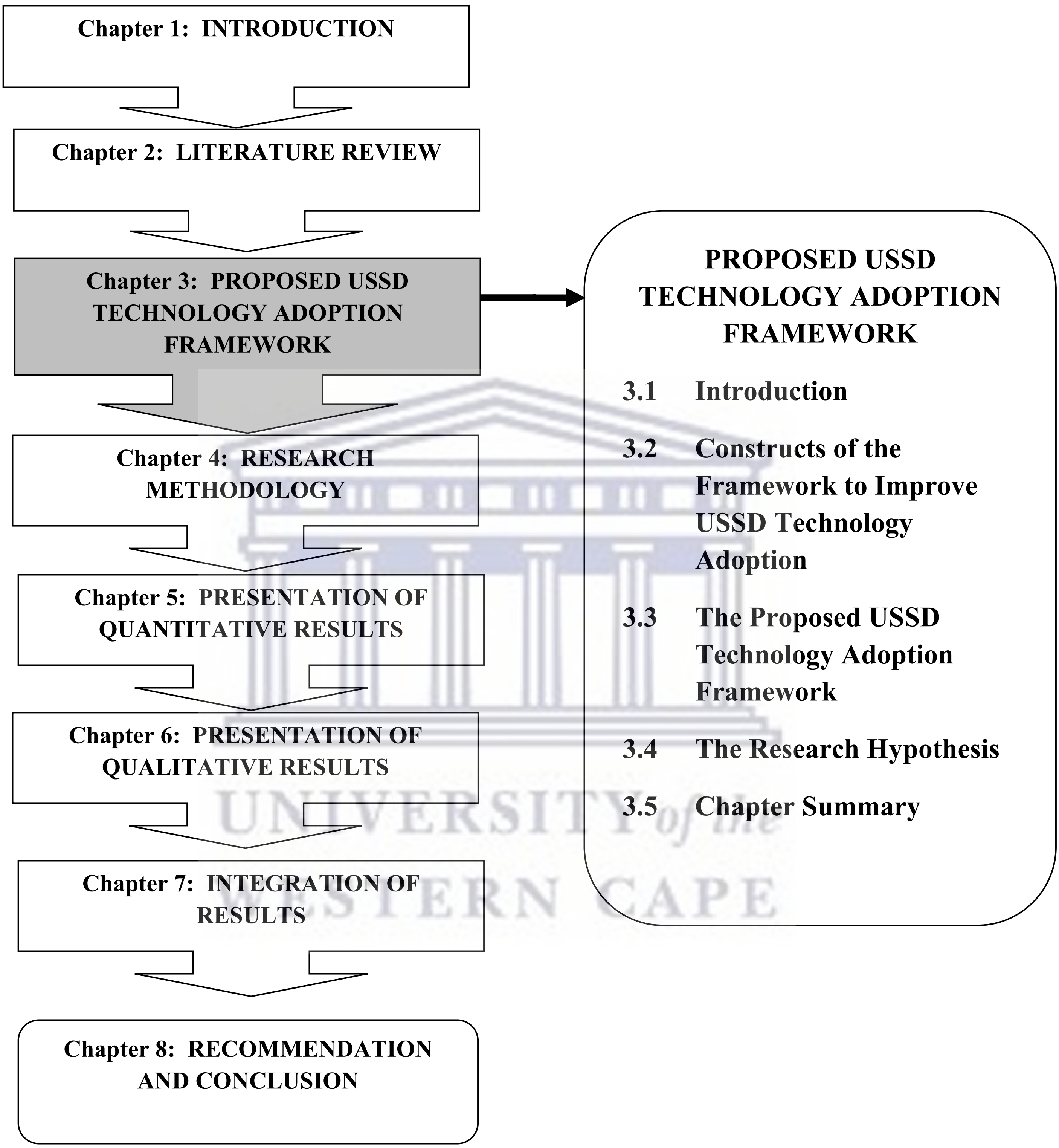


Figure 3.0: Diagrammatic Overview of the proposed USSD technology adoption framework

CHAPTER 3 – PROPOSED USSD TECHNOLOGY ADOPTION FRAMEWORK

3.1 Introduction

This chapter established the theoretical foundation for the study's proposition of a USSD technology adoption framework. It offers a theoretical rationale for the constructs for the framework and, as a result, explains the approach used in conducting the study methodology. As elucidated in the preceding chapter, IS research offers an interdisciplinary approach to understanding a phenomenon from a multi-disciplinary standpoint. It provides the necessary insight into the direct and indirect impact of constant technological change, such as that seen in the digital financial services industry, which simultaneously creates threats and opportunities without taking into account the effect of the technology's features and capabilities on the customer's purpose and incentive to use the system (Granić, 2023; Hanouch & Chen, 2015; Lai, 2017). The TAM, Stimulus-Organism Theory, and Information System Success Theory are theories underpinning the proposed research.

A literature review of these theories has been provided in the previous chapter, and it shows that the framework presented in this chapter has been framed around TAM, S-O-R, and IS models. In addition, this chapter discusses constructs of the USSD technology adoption framework and how the research hypothesis has been laid out to pave the way for data collection and analysis. In this chapter, 3.2 discusses the constructs of the USSD technology adoption framework, 3.3 presents the diagrammatic view of the proposed framework, and 3.4 examines the research hypothesis.

3.2 Constructs of the Framework to Improve USSD Technology Adoption

3.2.1 Stimulus

Scholars have suggested that to navigate the intricacies of technology adoption research, it is advisable to consider both the characteristics and capabilities of the technology itself, as well as the underlying factors that drive consumer acceptance (Al-Rahmi et al., 2021; Justino et al., 2022; Momani, 2020). In extending TAM, Lai (2017) developed the Stimulus-Organism Model by incorporating the design and security constructs as external variables. The two constructs were used to investigate the impact on consumer's intention to use e-payment technology. Lincoln (2005) suggests that the technology's quality criteria, validity, and reliability are essential determinants of adoption. As discussed in section 2.7 of Chapter 2, a combination of TAM, IS Success, and SOM Model constructs are presented as the stimulus (Lai, 2017). In proposing a USSD technology adoption framework for this study, the stimulus constructs hypothesised are the features, attributes, and capabilities of USSD technology to perform digital financial services.

3.2.1.1 Design

According to Lai (2017), design is the technology's technical ‘‘design and functionality’’ in the Stimulus Organism Model. In the design of USSD technology, ease of navigation is a considerable factor influencing consumers to adopt it (Mallik et al., 2020a). Similarly, in the technical design of USSD technology, alphanumeric character inputs are required on the mobile device to enable real-time interactive communication between mobile phones and service applications; this is one of the design benefits of USSD technology. However, Mallik et al. (2020a) suggest it does not require internet access or a smartphone, which might be a challenge for many users regarding interactiveness. USSD is mostly self-service operated and only requires dialling codes and strings on the mobile device. Research has shown that consumers enjoyed using mobile-based payments and valued the benefits of the design that provided ease of use and usefulness.

Other academic researchers opined that the design of a technology innovation would positively impact the adoption and usage of the innovation (Munene & Kasamani, 2017). Contrastingly, one of the limitations of USSD technology by design is plain text PIN, which tends to demotivate consumers to perform digital financial services using USSD technology (Luo et al., 2010). For this study, the design construct adapted from the Stimulus Theoretical Model has the following dimensions: instructiveness of the USSD solution, simplicity and logical progression of tasks without unnecessary repetitions, simplified operations, and task clarity.

3.2.1.2 Security

Security and privacy are increasingly becoming essential to customers; it influences whether they will choose an innovation or not based on the level of security and privacy that an innovation or mobile device offers. It is the degree of risk (Wanuna, 2020). El Janati El Idrissi et al.(2017) examined the security model of mobile banking applications concerning attack simulation and countermeasures. The authors assert that the security issues in technology adoption have significant implications on consumers' intention to use, as they introduce vulnerabilities that enable attackers to gain control of the phone and access private data. USSD technology security is vital in determining the decision of consumers to adopt and use (Otor et al., 2020). Based on these security concerns, Wanuna (2020) opined that using USSD technology for digital financial services can be risky if proper cybersecurity measures are not activated because USSD packets are transmitted in clear text over Global System for Mobile (GSM) communications standard (Neza et al., 2022).

With an increasing wave of SIM swaps in USSD technology usage, Hanouch & Chen (2015) argued that improving security increases user trust and adoption of USSD technology. Subscriber

Identification Module (SIM) swap occurs when a network user changes their SIM with a new SIM and transfers their data or existing number to the new SIM for fraud. Wanuna (2020) developed a dynamic knowledge-based authentication model for enhancing the security of USSD banking transactions due to its vulnerability due to the six-digit PIN transmitted in plain text. Findings from the research indicate that security is a significant challenge when adopting USSD technology. Therefore, building trust through security with consumers is one of the key areas that organisations must prioritise when creating and marketing payment products and services. By definition, security is being protected or safe from harm. In this study's USSD technology adoption framework, the security construct adapted from the Stimulus Theoretical Model encompasses three dimensions: reliability, safety, and privacy, based on their influence on technology adoption.

3.2.1.3 System Quality

In the review of the IS Success model, DeLone & McLean (2002) suggest that system quality is a measure of the impact of the Success of adopting the technology. In the review of technology adoption, existing standards with adequate and acceptable qualities must be measured to determine their impact (Petter et al., 2008). Poor service quality potentially impacts user experience and consumer trust (Hanouch & Chen, 2015). According to the Bank for International Settlement (BIS, 2021a), system quality in any form of payment system, including mobile-based payments, is a measure of the performance of the information. This can also be viewed from technical and design perspectives (DeLone & McLean, 2002). As discussed in Chapter 2 of the study, USSD technology relies on the mobile network infrastructure's availability, security, and reliability. However, complaints about the quality of services and reliability due to network congestion and implications for the quality of voice and SMS services have a considerable propensity to demotivate users from adopting the technology (Hanouch & Chen, 2015).

The constructs of the study's system quality are adapted from the IS Success model. USSD technology quality in the context of this study is discussed in terms of ease of use, functionality, reliability, data quality, system accuracy, flexibility, sophistication and integration, and real-time system capability (Błach & Klimontowicz, 2021).

3.2.1.4 Information Quality

Within the IS success model, the concept of information quality pertains to evaluating the outputs generated by the information system (DeLone & McLean, 2002). This can be expressed in improved authentication and efficient processing of new payment products and services (Harasim & Klimontowicz, 2013). According to a World Bank report (The World Bank, 2016), USSD is a simple technology with limited functionality and interoperability limitations, making it difficult to support more complex services. On the contrary, banks have recently started creating unique, customized, dedicated USSD-based solutions for their consumers (El Janati El Idrissi et al., 2017). Prior studies have shown a notable obstacle in seamless integration between mobile-based financial services, such as USSD, and conventional banking services (perceived usefulness). This problem is especially evident in areas that have several mobile network carriers and banks (Iriobe et al., 2021).

However, with recent technological advancements, banks can interoperate USSD-based services seamlessly with other bank players using a shared service infrastructure within the country.

3.2.2 Organism

As discussed in Chapter 2, Lai (2017) developed the Stimulus Theoretical Framework as an extension of TAM. The framework incorporates the user experience design and security constructs as external variables in addition to original constructs of perceived usefulness and perceived ease of use, which are part of TAM. As Granić (2023) and Sadeck (2022) noted, adapting the stimulus theory provides additional lenses for the study to investigate the impact of USSD technology features and capabilities on consumers' behavioural decisions to adopt the technology to perform digital financial services. According to Lai (2017), organisms in the context of this study are motivating factors for the adoption and usage of the USSD technology to perform digital financial. They represent the perceived ease of use and usefulness in TAM, ultimately leading to consumers' response to the system (Lai, 2017).

3.2.2.1 User Experience (UX)

The increasing significance of the mobile phone as a novel direct interactive medium lies in its mobility and capacity to serve as a portable device, which has been recognized as providing users with a new experience (Muk & Chung, 2015). Concerning user satisfaction, David-West (2020) argued that user experience directly affects consumers' satisfaction level of a service. It moderates how service providers could understand customers (existing and prospective) regarding customer attitudes, perceptions, satisfaction, and even psychographic principles for them to adopt new technological-based products and services. According to Otor et al. (2020), user experience facilitates customer emotions in adopting and using technology. It provides a conventional analysis of consumers' perception of tangible benefits after using a product or service (Otor et al., 2020). Due to its continuous need to adapt to consumer needs over time due to evolving use conditions and technological changes, user experience expresses consumer satisfaction level when individuals engage with and encounter a certain product (Mallik et al., 2020a).

User experience is not limited to satisfaction or experience when accessing digital media channels or online applications (Lutfi et al., 2022). It provides a unique satisfaction from using technology, products, or services with less effort (Mogaji et al., 2020). As a newly introduced construct in the USSD technology adoption framework and due to its continuous influence on consumer technology adoption intentions to perform digital financial services and to accelerate digital financial inclusion (David-West et al., 2018). In this study, user experience is substituted into the proposed USSD technology adoption framework as a new construct. Dimensions of user experience include ease of use, faster resolution of complaints, good service quality, and low transaction costs. Research has shown that a better consumer experience with a simplified USSD technology interface, ease of use, and prompt issue resolution improves the consumer's experience (Shailza & Sarkar, 2019) and motivates consumers to adopt USSD technology (Luo et al., 2010).

3.2.2.2 Perceived Usefulness

Perceived usefulness (PU) is one of the constructs in TAM, described as the extent to which users expect the application of technology to improve their performance or achieve their desired purpose (Muk & Chung, 2015). According to Lai (2017), PU refers to the degree to which a person has the belief that using an information system can effectively augment productivity. Also, it relates to the extent to which an individual believes utilising an information system will improve productivity. It directly influences attitude toward systems use and behavioural intention to use the system (Venkatesh et al., 2007). To further describe its influence on the design, use, and behavioural intention to use the system, Al-Kofahi et al. (2020) argued that perceived usefulness provides the consumer with an expectation to be derived from using the technology. Regarding perceived usefulness related to USSD technology, GSMA (2022a) opined that USSD technology provides the most affordable global access to digital financial services for the low-income population.

This is supported by the views of Hanouch & Chen (2015) that usability, user experience, and cost are essential components of perceived usefulness, making USSD the preferred technology to perform digital financial services. As proof of its ubiquity and capability to work on the vast majority of phones, researchers (Mallik et al., 2020a) developed a USSD application with banking features for the unbanked populace to use without going through the banking process. Because USSD technology is agnostic of mobile phones and supports everyday activities (GSMA, 2022a), users would find it more valuable, and it directly influences their attitudes and behavioural intention to use mobile phones (Al-Kofahi et al., 2020). In TAM, PU predicts behavioural intention to use technology (Lai, 2017). The PU constructs for the study follow the views of Hanouch & Chen (2015) and Al-Kofahi et al. (2020), who suggest simplicity, accessibility, and affordability as significant elements of mobile technology's ease of use.

3.2.2.3 Perceived Risk

In reviewing the effects of perceived risk on technology adoption, Kelly & Palaniappan (2022) investigated the factors influencing mobile money transaction service adoption in Ghana using a Technology Acceptable Model and Diffusion Theory. The study's findings revealed that perceived risk significantly affects users' decisions to use mobile money banking services (Kelly & Palaniappan, 2022). Evidence from previous research on USSD technology adoption also shows that perceived risk leads to "perceived psychological risk" (Qiao et al., 2021; Taherdoost, 2022), which is the consumer's impression of any potential psychological dissatisfaction, pressure, or worry resulting from using USSD technology (Ramtiyal, Verma, & Rathore, 2022). Luo et al. (2010) opined that perceived risk is expressed in terms of consumers' feelings, for instance, anxiety, concern, discomfort, uncertainty, and cognitive dissonance when using technology.

According to research, consumers may be significantly impacted by the perceived risk dimensions of using new technology, including anxiety, concern, discomfort, uncertainty, worry, despair, tension, and cognitive dissonance (Ramtiyal et al., 2022). Similarly, in the implementation of a digital financial inclusion agenda or the roll-out of mobile-based digital financial services, Velazquez, Bobek, Vide, & Horvat (2022) argued that potentially adverse effects of acquiring a new product or service give rise to a well-known and significant notion in consumer behaviour which are critical attributes of perceived risk. According to the literature, because customers will have considerable inhibitions, perceived risk is one of the most important aspects to consider when adopting new technological applications (Kelly & Palaniappan, 2022). Consumers' perceived risk and risk tolerance has been established to influence their decision (Luo et al., 2010).

3.2.2.4 Perceived Trust

Scholars (Esmaeili et al., 2021) have researched the elements of perceived trust about social impact and consumer loyalty in the adoption of mobile banking, in addition to examining variables that contribute to satisfaction. From a more comprehensive outcome of their investigation, trust has been described as a behavioural belief that significantly affects consumers' intent to use technology (Gbongli, 2022). It is a self-belief that the other party will behave responsibly and will not attempt to exploit the vulnerabilities of the user (Jocevski, Ghezzi, & Arvidsson, 2020). According to Jocevski, Ghezzi, & Arvidsson (2020), perceived trust is defined as the belief that the other party will behave responsibly and will not attempt to exploit the vulnerabilities of the user. Perceived trust is another essential factor influencing the adoption and use of USSD technology for digital financial services.

Similarly, perceived trust has been described as a behavioural belief favouring consumers' intent to use technology such as the USSD technology (Macharia et al., 2022). In a study by Olaleye, Sanusi, & Oyelere (2017), users who trust USSD technology are likely to have a better user experience and are more likely to adopt and use it for digital financial services. The importance of trust is heightened when there is a high degree of uncertainty, which can happen when users don't understand where their information is being stored or how it is being transmitted. Mallik et al.(2020a) opined that the importance of perceived trust is heightened when there is a high degree of uncertainty, which can happen when users don't understand where their information is being stored or how it is being transmitted. In a study to review factors affecting digital payments and adoption behaviour for mobile e-wallets, Bhag (2014) identified perceived trust as a determining factor.

This also corroborates the views of Mallik et al. (2020a), who suggest that affordability around bank charges, efficient system uptime, good customer support, and usability significantly impact trust in adopting technology. Having discussed the constructs of the proposed USSD technology framework, the following section highlights the research hypothesis which forms the basis for data collection and analysis.

3.3 The Proposed USSD Technology Adoption Framework

Generally, a framework refers to a tangible or abstract structure designed to function as a foundation or roadmap for developing a construct that enhances the use of such structure. The present study used pre-existing theoretical frameworks to construct a modified USSD technology adoption framework that could be employed in quantitative and qualitative research. The study examined how USSD technology adoption can be improved to perform digital financial services. As discussed in the literature review chapter (Chapter 2), USSD technology is a product of mobile technology innovation and evolution, which has played a significant role in access to digital financial services in Nigeria. Based on the constructs outlined in section 3.2 of this chapter, the study proposes a framework to improve USSD technology adoption for digital financial services in Nigeria to address the study's objectives.

Leveraging on previous IS theories as the basis for the study, constructs of the TAM and IS Success model were adapted and integrated into the Stimulus-Organism Theory to develop a USSD technology adoption framework for the study.

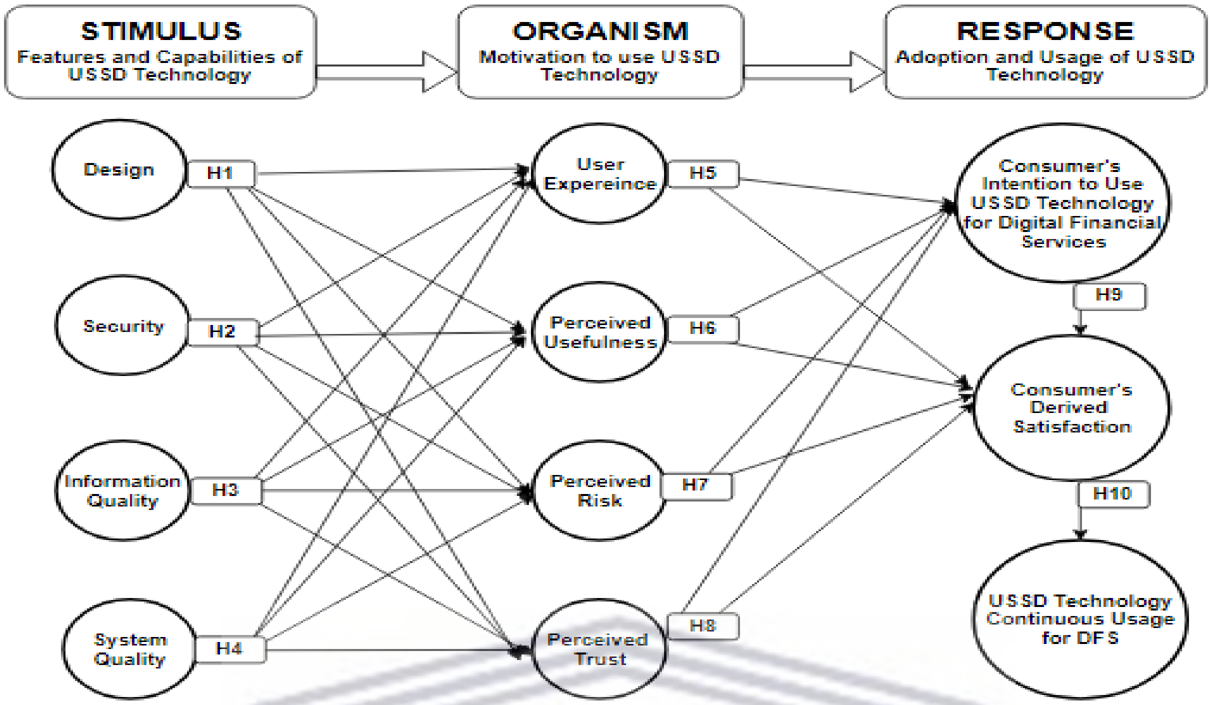


Figure 3.1: Proposed USSD Technology Adoption Framework

3.4 The Research Hypothesis

Based on the research framework, the following hypothesis was derived and will be used to develop the questionnaire for the study. The hypotheses for this study are presented in their null forms:

Hypotheses 1: Design - USSD technology design (interactivity, clarity, and simplicity of USSD interface design) significantly impacts consumer's motivation to adopt USSD technology to perform digital financial services

Hypothesis 2: Security – USSD technology security (reliability, safety, and privacy) significantly impacts consumer's motivation to adopt USSD technology to perform digital financial services

Hypothesis 3: Information Quality – USSD technology information quality (performance, data quality, flexibility, accuracy, and capability) significantly impacts consumer's motivation to adopt USSD technology to perform digital financial services

Hypothesis 4: System Quality - USSD technology system quality (authentication process, information quality, and processing capability) significantly impacts consumer's motivation to adopt USSD technology to perform digital financial services

Hypothesis 5: User Experience – USSD technology user experience (consumer perception of, intention to use, experience of, and feelings towards use) significantly impacts consumer's adoption and usage decisions to use USSD technology for digital financial services

Hypothesis 6: Perceived Usefulness – USSD technology's perceived usefulness (the extent to which an individual believes that using USSD technology enhances their tasks) significantly impacts consumer's adoption and usage decisions to use USSD technology for digital financial services

Hypothesis 7: Perceived Risk – USSD technology's perceived risk (due to anxiety, concern, fraud, discomfort, and uncertainty) significantly impacts consumer's adoption and usage decisions to use USSD technology for digital financial services

Hypothesis 8: Perceived Trust – USSD technology's perceived trust (in terms of reliability of service providers, satisfaction in, and improvement significantly impacts consumer's adoption and usage decisions to use USSD technology for digital financial services

Hypothesis 9: Intention to Adopt and Use – Consumers' intention to adopt and use USSD technology significantly impacts derived satisfaction when performing digital financial services

Hypothesis 10: Derived Satisfaction – Consumer's derived satisfaction from using USSD technology for digital financial services significantly impacts USSD technology's continuous usage for digital financial services

3.5 Chapter Summary

The chapter presents a USSD technology adoption framework for the study. Developed from TAM, IS Success Theory, and Stimulus Organism constructs and then introducing user experience and design as additional constructs for the study, the proposed framework provides the basis for developing data collection instruments for both quantitative and qualitative analysis. Furthermore, the chapter offered theoretical background on the suitability of the constructs for each of the three themes of the proposed USSD technology adoption framework, which are stimulus factors (features and capabilities of the USSD technology) and organism factors (motivating factors for using USSD technology) on the respond (adoption and use of USSD technology) for digital financial services in Nigeria. As discussed in the chapter, four constructs were derived under the Stimulus (design, security, system quality, and information quality), and three constructs were derived under the Organism (user experience, perceived usefulness, perceived risk, and perceived trust).

Furthermore, TAM will help understand the motivations for adopting improved USSD technology. S-O-R will help to understand the internal response of consumers to the external stimuli of an improved USSD technology built on an information system (IS) powered by mobile technology innovations.

The chapter also discussed the research hypothesis to ensure the study addresses the research questions on determining factors that would improve USSD technology adoption for digital financial services in Nigeria. The following chapter presents the research methodology.

CHAPTER 4- DIAGRAMMATIC OVERVIEW

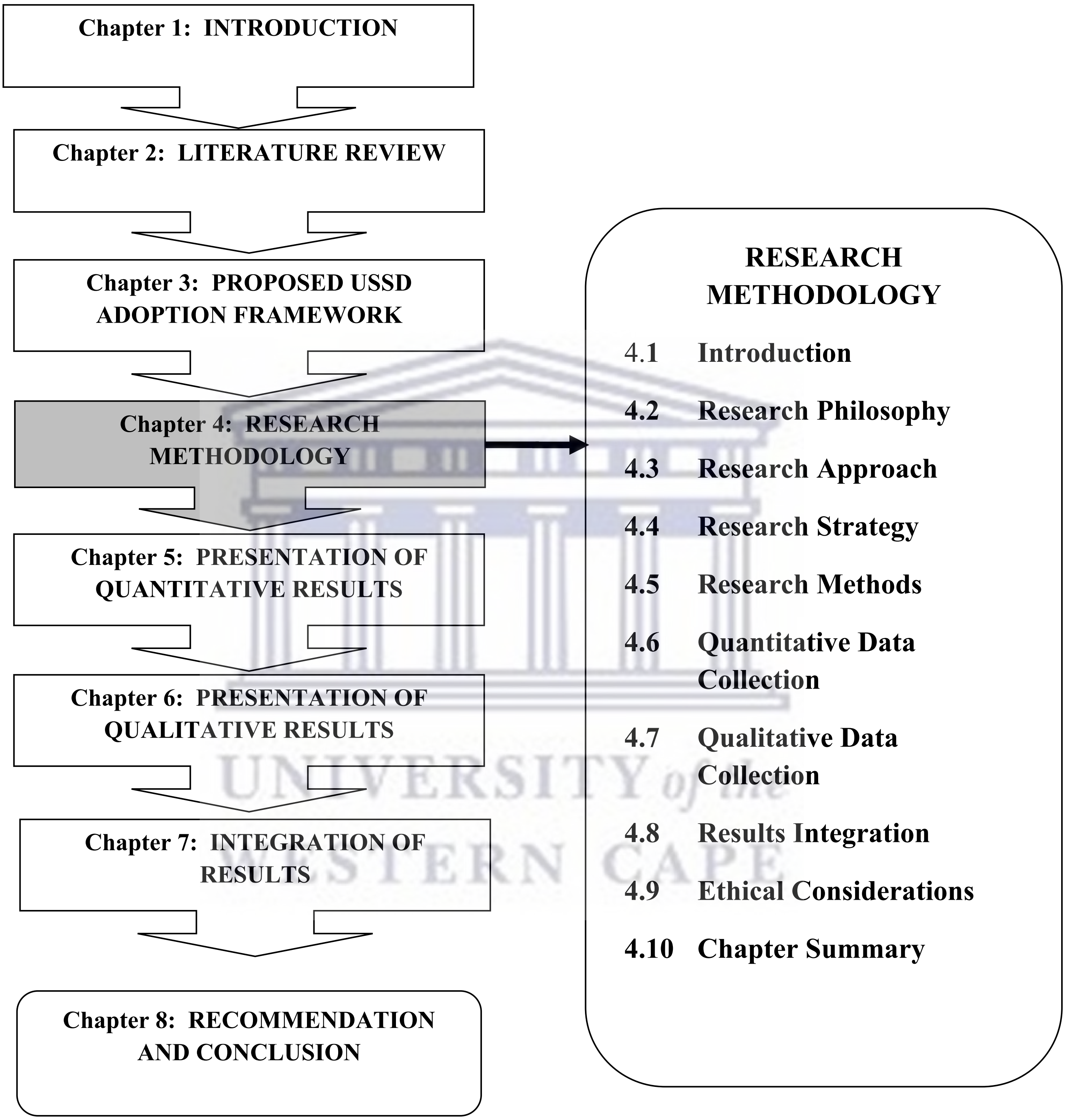


Figure 4.0: Diagrammatic Overview of the Research Methodology

CHAPTER 4 – RESEARCH METHODOLOGY

4.1 Introduction

Research entails a methodical and structured investigation into a particular phenomenon. It refers to the process through which the researcher accomplishes answers to research questions (Khatri, 2020). The term research has been defined in various ways by different scholars in the field. Ugwu et al. (2021) described the research as a systematic investigation that seeks to generate knowledge and information to address specific issues or challenges (Gunasekare, 2015). Said (2023) further described research as a methodical endeavour individuals pursue to acquire information and gain insights. Methodology is a comprehensive phrase used to denote the many study methodologies, plans, methods, and processes employed in a meticulously organized inquiry to acquire knowledge or understand (Ugwu et al., 2021). In an attempt to perform research, a research methodology is employed, and consequently, researchers have advanced different methodologies to carry out their research (Hidayat-Ur-Rehman et al., 2021; Miles, 2017; Wicaksana & Rachman, 2018).

Research methodology is crucial in conducting empirical studies in scientific research as it systematically examines phenomena using scientifically approved procedures (Wicaksana & Rachman, 2018). These approaches form the fundamental components of research methodology. Igwenagu (2017) describes research methodology as a systematic and theoretical examination of the methodologies used within a study area based on the underlying research framework. According to Kumatongo (2021), the concept of research methodology can be expressed as a structured procedure informed by a theoretical framework and hypothesis used to research natural phenomena. In an attempt to define research methodology, Doyle et al. (2009) systematically delineate the analysis and technique used to substantiate the theoretical framework of the research, providing a comprehensive overview of the information that affected the study's findings.

This perspective is consistent with the assertions made by Kumatongo (2021), who argues that research methodology encompasses a collection of systematic approaches used in research to streamline the study process and its execution. Moreover, the research technique contains a comprehensive strategy and underlying logic to accomplish the study goals (Khatri, 2020; Ugwu, Ekere, & Onoh, 2021). The present and continuous transformations occurring in the technical, social, and anthropological contexts within which the society operates have created a significant drive towards developing novel research methodologies in IS research (Vivek, 2022). Similarly, because academic research demands the examination of a phenomenon using scientifically acknowledged procedures, several aspects of an investigation, including the design, data collection procedures, data analysis methods, instruments, and details of the specific treatments within the study, are components of a research methodology (Bans-Akutey & Tiimub, 2021; Said, 2023; Sivan, 2023).

Following the arguments of another researcher, Kumatongo (2021) posits that research methodology consists of a series of well-thought-out and carefully executed activities that enable the study to communicate how identified problems can be solved or at least considerably minimised from a theoretical lens (Khatri, 2020). This makes research methodology one of the essential parts of research (Ugwu et al., 2021), and it also involves the procedures used to study the theories or principles that underpin the research objectives (Ivankova, Creswell, & Stick, 2006). In considering the methodology for research, Said (2023) suggests critical questions to ask: how will the research be conducted, what are the required data sets, what are the data collection instruments, what are the data analysis techniques, and how will the data be analysed to answer my research question(s) and thus make a contribution to the body of knowledge?

This implies that research methodology encompasses a research paradigm (a philosophical way of thinking to achieve a research objective), theoretical model, data gathering techniques, sampling population identification, data analysis procedures, and presentation strategy as essential components of research methodology (Khatri, 2020; Kumatongo, 2021; Morgan, 2007). Also, evidence from previous research has shown that research methodology helps link the problem statement and the outcome of the research objectives (Khatri, 2020; Kumatongo, 2021; Ugwu et al., 2021). Following these definitions and background, research may be seen as a methodical and intellectual endeavour to accumulate knowledge, authority, and influence within its respective domain (Khatri, 2020). The theoretical foundation for improving the adoption and decision-making of USSD technology was discussed in the preceding chapter. This chapter discusses the research methodology adopted for the study to investigate the proposed USSD technology adoption framework for digital financial services in Nigeria.

This chapter further systematically describes the analysis and approach that underpins the investigation of the suitability of the study's proposed USSD technology adoption framework. This is reviewed from a broader view of the body of knowledge to respond to the research question and objectives outlined in Chapter 1 of this study. This methodology aligns with the assertions made by other researchers since it employs a multidisciplinary approach to provide the theoretical underpinnings for studying the process of technology adoption decision-making (Idriss & Ajiya, 2022). An interdisciplinary approach to understanding technology innovation adoption determinants such as USSD technology also aligns with the outcome of previous research on the technology adoption decision-making process as postulated by Idriss & Ajiya (2022) and Lai (2017).

Following this introduction, the proceedings of this chapter follow thus: Section 4.2 provides an overview of the research philosophy, section 4.3 examines the research approach, section 4.4 explores the research strategy, section 4.5 delves into the research methods, section 4.6 discusses the collection of quantitative data, section 4.7 discusses the collection of qualitative data, section 4.8 addresses the integration of results, section 4.9 considers ethical considerations, and section 4.10 provides a summary of the chapter. The following section discusses the research philosophy, establishing the underlying beliefs that shape the research methodology.

4.2 Research Philosophy

According to Cresswell, 2013 (cited by Kumatongo, 2021), research philosophies are often used as the fundamental basis for conducting research. Within the realm of inquiry, the term "philosophy" encompasses the underlying epistemological, ontological, and axiological assumptions (Vivek, 2022). In the twentieth-century social sciences, philosophical approaches have been used to understudy a phenomenon to derive a research outcome (Shan, 2022). In IS research, the philosophical concept is regarded as the foundation for a sequential organisation of components under research methodology, which requires research paradigms and designs to provide a sequential perspective and a philosophical framework to guide the study of interest (Ugwu et al., 2021). Kumatongo (2021) describes epistemological, ontological, and axiological principles as philosophical foundations in academic research.

Crotty (1998) further explains that in IS research, there are four major elements in designing an intellectual framework in a study. These are paradigm or worldview, which encompasses ideas such as epistemology and ontology; theoretical lens, which comprises perspectives such as feminist, racial, and social theories; methodological approach, which encompasses strategies like ethnography, experimentation, and mixed methods; and data collecting practices, which contain techniques such as interviews, checklists, and instruments (Babbie, 2008; Neuman, 2014; Shan, 2022). For these reasons, scholars suggest the importance of ascribing a research inquiry to a guiding principle of a paradigm, philosophy, or theoretical base (Aalberg, Strabac, & Brekken, 2012). According to Kumatongo (2021), epistemology (derived from the Greek word epistêmê, which means "knowing.") is the philosophy of knowing, or 'how' a researcher understands reality and beliefs about how knowledge should be obtained and accepted. In Ugwu et al. (2021), epistemology is the proper term for disputes on the nature of knowledge and how we come to know.

Their arguments are pointers to questions like "What exists?", "What is knowledge?" and "How do we gain knowledge?" have captivated philosophers and academics in various professions. To advance these philosophical arguments, Morgan (2007) identifies five distinct research paradigms: positivist, post-positivist, constructivist, participatory, and pragmatist. As mentioned above, the paradigms exhibit variations in their level of universality in worldviews and epistemologies. While Creswell & Plano (2011) argue that positivists and post-positivists are more associated with the quantitative research approach. In contrast, constructivists are more associated with the qualitative research approach. Crotty (1998) opined that ontology is the philosophical study of what may be claimed to exist but varying degrees of diverse perspectives from IS scholars. According to scholars, Epistemology, the most general level of philosophical assumptions, shows how scholars learn about what they know (Khatri, 2020; Kumatongo, 2021; Morgan, 2007; Ugwu et al., 2021).

Each theoretical viewpoint incorporates a specific vision of existence and reality (ontology) and a specific grasp of what it means to know (epistemology). Ontology is defined by Crotty (1998) as a community-based worldview regarding the nature of our world. According to Creswell & Plano (2011), Ontology is the study of being that informs the theoretical viewpoint alongside epistemology as indicated by Creswell & Plano (2011). In Ugwu et al. (2021) and Kumatongo (2021), the philosophical foundations of research drive the curiosity and knowledge to derive the research outcome. Creswell & Plano (2011) further argue that knowledge is the assumptions about reality. They provide the paradigms (worldviews) that shape the research's development and ultimately serve as the foundation for the researcher to clearly articulate how different paradigms will be integrated to answer the research question. Following these arguments and using an appropriate methodological framework that suits the research objectives (Monageng, 2023), this study seeks to investigate the proposed framework to improve USSD technology adoption to perform digital financial services in Nigeria.

The knowledge derived would assist regulators, banks, and telecommunications companies understand what significantly impacts consumers' decision to adopt USSD technology for digital financial services within the Nigerian banking ecosystem. From a review of theoretical assumptions that underpin a study, Toyon (2021) argued that researchers often operate within the domain of paradigms, which offers a comprehensive framework for their overarching research approach. In the context of this study and to answer the research question while investigating constructs of the Stimulus, Organism, and Response (S-O-R) factors on USSD technology adoption for digital financial services in Nigeria, the study highlights four levels of philosophical assumptions as part of the study which is described in Figure 4.1. As shown in Figure 4.1, Crotty (1998) suggests a four-level systematic procedure to address the research question and achieve the study's objectives. This study also adopts this approach to provide a philosophical basis for investigating the proposed framework to improve USSD technology adoption.

Similar to the views of Creswell & Plano (2011), a philosophical framework aids in positioning and articulating how the research process is designed.

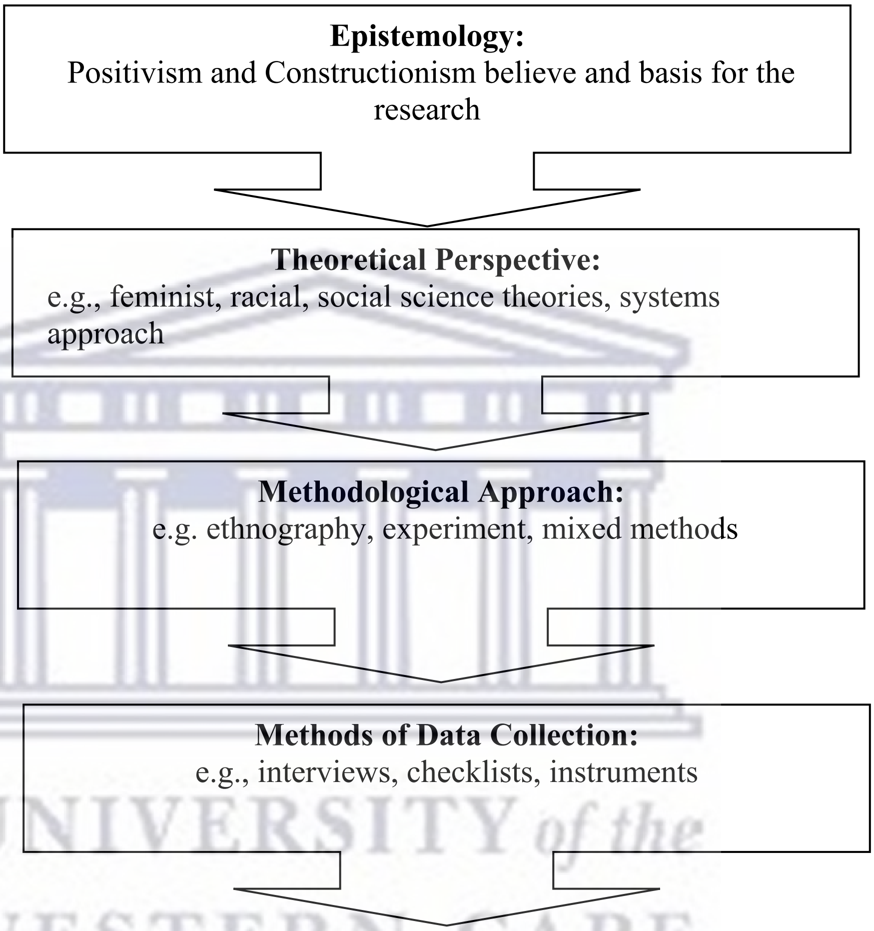


Figure 4.1: Four Levels for Developing a Research Study (Source: Adapted from Crotty; 1998)

As discussed in chapters one and two of the study, the premise for investigating the USSD technology adoption framework is multi-faceted and requires the integration of more than one IS theory to ensure the derived framework for the study. This approach is a philosophical assumption drawn from a particular theory that complements the base theories and also dictates the study's questions, objectives, and data-gathering method (quantitative, qualitative, or both) (Said, 2023; Toyon, 2021; Vivek, 2022). Finally, the methodological approach discussed above to investigate the proposed USSD technology adoption framework will guide the processes and procedures for data gathering, analysis, and interpretation, a philosophical belief that governs the study inquiry (Kumatongo, 2021). The following sub-section discusses the research paradigm adopted for the study, which entails associated worldviews and assumptions.

4.2.1 Research Paradigm

According to previous literature (Ugwu et al., 2021), the choice of research paradigm determines the methodological approach to inquiry. Diverse perspectives on social reality lead to varying ideas on the underlying logic that guides the formulation of an investigation. The scientific approach encompasses the dynamic interaction of three key components: abduction, induction, and deduction. Abduction refers to accepting explanatory plausibility, while induction involves empirically testing potential conclusions. Deduction, on the other hand, means extracting implications from accepted inferences (Toyon, 2021). Towards the investigation of the proposed USSD technology adoption framework for this study, it is crucial to examine the research paradigm to ensure that the study's objectives and outcomes are well understood. Jokonya (2014) describes a research paradigm as a fundamental and comprehensive belief system that helps researchers classify similar theorist perspectives in their approach to a problem.

From a world-view standpoint and given the transdisciplinary approach in IS research, Jokonya's (2014) views also align with Vivek (2022), who defines a paradigm as a basic set of beliefs or worldviews that guides research action or an investigation using a specific research technique. Other researchers (Brannen, 2005; Ugwu et al., 2021) describe research paradigm as a framework that assists scholars in understanding the epistemological and philosophical consequences of their perspective and underlying assumptions. According to Khatri (2020), research paradigms provide a perspective to view the research phenomena based on the researcher's worldview perspective, thinking, school of thought, or set of shared beliefs that inform the meaning or interpretation of research data. They are further described as shared beliefs, ideas, assumptions, and agreements on how a study might understand and address issues (Lincoln, 2005). Morgan (2007) posits that research paradigms allow researchers to express their beliefs and efforts to create knowledge.

In support of the argument by Morgan (2007), Doyle et al. (2009) opined that the research paradigm also allows researchers to conduct their research within a particular paradigm and from several investigation perspectives, providing the theoretical or philosophical ground for the current and future research work (Doyle et al., 2009). However, the literature review on information systems (IS) that examines technology adoption research reveals a paradigmatic framework. This framework is utilised to explore technology adoption, such as USSD technology. Its purpose is to aid researchers in gaining a deeper understanding of the epistemological and philosophical implications of their perspective and underlying assumptions (Igwenagu, 2017; Morgan, 2007). To further assess scholarly arguments on the relevance of paradigmatic framework, scholars (Doyle et al., 2009; Ugwu et al., 2021) contend that the three fundamental problems of ontology, epistemology, and methodology are addressed by several paradigms that exist simultaneously and compete in a given tradition held by a particular group. However, scholars (Said, 2023; Sivan, 2023; Toyon, 2021; Vivek, 2022) argue that the verification process precedes theory formation in contemporary sociological research.

Moreover, it is worth noting that the phrases worldview, theoretical lens, and paradigm are often used interchangeably within this context. Evidence from other literature also suggests that participants and researchers try to understand a phenomenon from several perspectives to develop their interpretations of reality (Maforah & Leburu-Masigo, 2018). This also strengthens the argument of Morgan (2007) and Theodorou (2013) that the values of the research paradigm influence the researcher's observations of reality. In expressing the most essential, modern, and prominent paradigms in research, literature (Forni & De Grande, 2020; Pashaie, Abbaszadeh, Abdavi, & Golmohammadi, 2023; Vivek, 2022) suggests positivist, post-positivist, constructivist, participatory, and pragmatist as research paradigm perspectives. As Crotty (1998) indicated earlier, the universality of these paradigms' worldviews and epistemologies differs, and it is essential to critically analyze their impact on a research problem (Shan, 2022).

Within scientific research, Khatri (2020) attributes the researcher's capabilities to include the selection of research subjects, the methodology used in the investigation, and the later interpretation of the results derived from the research, which significantly impact several aspects of the research process. This aligns with the views of the significance of research paradigms in their encompassing concepts and principles that define academic activities within specific fields. In the discussion of the research paradigm adopted to investigate the proposed USSD technology adoption framework for the study, a literature review of philosophical analysis of the research paradigm is presented. These include positivism, constructionism, critical realism, and pragmatism. According to Ugwu et al. (2021), French philosopher Augustine Comte popularised the positivist paradigm, who believed that observation and reasoning were the best ways to understand human behaviour.

According to Comte 1855 (cited by Ugwu et al. (2021)), the positivist paradigm is a philosophy that relies on observation and reason to understand human behaviour or that sees human beings as phenomena that can be studied scientifically (Khatri, 2020). In essence, it entails the reduction of individuals to quantifiable entities that may be subjected to scientific inquiry (Ugwu et al., 2021). Kumatongo (2021) opined that in the positivist world, actual knowledge is based on sensory experience and obtained through observation and experimentation. Similarly, scientific research using a positivist approach adopts statistical methods to make inferences about research objectives (Toyon, 2021). At the ontological level of scientific research, proponents of positivism adhere to the assumption of realism, which asserts the existence of a singular reality (Forni & De Grande, 2020; Pashaie et al., 2023; Vivek, 2022).

This assumption implies that truth is objective, capable of being quantified, and measured through methods independent of the researcher. In Shan (2022), the postpositivist position consists of 'ontological', 'epis- temological', and 'axiological' assumptions, in which 'ontological' assumptions are privileged over other beliefs. Similarly, Creswell & Plano (2011) argue that positivist and post-positivist research approaches are more related to quantitative research. Again, Doyle et al. (2009) suggest that positivist and post-positivist perspectives are connected with quantitative research methods. Jokonya (2014) also mentions that positivism is a scientific technique inherited from the natural sciences that believes in an ordered and regular worldview that can be objectively explored. Having reviewed all these assertions, Morgan (2007) opined that reality is tangible, discoverable, quantifiable, and independent of the observers (Morgan, 2007).

To carefully test constructed hypotheses of a research framework similar to the proposed USSD technology adoption framework for this study under the positivism paradigm, Creswell & Plano (2011) and Morgan (2007) argued that the researcher is seen as separate and objective in the positivist and post-positivist by analysing factors that can be quantitatively tested and observed to achieve the study's objectives. In their arguments, Creswell and Plano Clark 2011 further contend that constructivism, also known as social constructivism, is based on the idea that people strive to grasp their environment by assigning subjective interpretations to their experiences. This also aligns with the views of Shan (2022), who posits that the constructivist (qualitative) viewpoint aids in eliciting different interpretations from participants, developing a deeper understanding than the quantitative approach with theory or response patterns that can explain quantitative data (Creswell & Plano Clark, 2011).

Unlike the positivist belief, Creamer (2017) opined that objective truth is criticised by constructionism; they hold the opposite view, which implies the world is fundamentally mental or mentally constructed, so constructionists do not search for objective truth (Creswell and Plano, 2011). In contrast to the philosophical approach of positivism, the interpretative method permits the acquisition of knowledge of reality through social constructs that are amenable to examination and dispute. It is noted in Theodorou (2013) that, as research in social science evolves, the continued debate on philosophical differences between positivist/post-positivist and constructivist paradigms contributed to tension, or "paradigm wars," among researchers. The paradigm war explains the nature of reality, the intimate relationship between the researcher and what is studied, and further emphasises the value-laden nature of inquiry (qualitative) compared to the measurement and analysis of causal relationships between variables (quantitative) within a research framework (Theodorou, 2013).

Many social and behavioural scientists have beliefs distinct and separate from positivism, post-positivism, or constructivism (Theodorou, 2013). This also aligns with the views of scholars (Creamer, 2017; Hamilton, 2018; Shan, 2022) who suggest that several paradigms exist simultaneously and compete in a given field. Instead of being limited by a particular paradigm to increase the tension, the pragmatism paradigm could be adopted to resolve the research challenge. In Ugwu et al. (2021), research paradigms and components can be classified to understand the philosophical consequences of their perspective and underlying assumptions. A comparison of these research paradigms and their features is summarised in Table 4.1.

Table 4.1: Comparison of Research Paradigms

Paradigm	Positivist	Interpretivist	Pragmatic
Ontology ***The researcher's perspective on the essence of existence or reality***	A single objective reality that is independent of social actors	Changes are possible in socially constructed, subjective, relativist, or multiple realities.	Relational or pluralistic reality. External, multiple perspectives selected to facilitate the answer to the research question best
Epistemology ***The researcher's perspective on what constitutes valid knowledge***	Objective. Focus on causality and law-like generalizations while reducing phenomena to their fundamental components. Rely on credible sources of data and facts.	Subjective. Social phenomena and subjective meanings. Concentrate on the situation's specifics, the truth hidden behind them, and the subjective meaning driving the behaviours.	Objective-Subjective, either or both, depending on the research question(s). Observable occurrences or subjective meanings might provide sufficient information depending on the study issue. Concentrate on practical, applied research, including many viewpoints to aid with data interpretation.
Axiology ***The researcher's perspective on how values play a role in research***	Research conducts the investigation without placing any values on the data, preserves	Research is value-bound and hence subjective; the researcher cannot be	Values play a significant influence in interpreting the findings. The researcher takes both objective and subjective points of view.

	impartiality, and is independent of the data.	separated from the subject of the inquiry.	
Design	Experimental, Quasi-experimental, Correlational, Causal-comparative	Grounded theory, Ethnography, Phenomenology, Case, study, Narrative inquiry	Convergent parallel mixed methods, Explanatory sequential mixed methods, Exploratory sequential mixed methods, Embedded mixed methods
Data Collection & Methodology	Questionnaire, Tests, Observation, Hypothesis testing, Probability testing, Statistical analysis	Semi-structured interview, In-depth unstructured interview, Non-probability sampling techniques, thematic analysis	Mixed methods of data collection and data analysis

Source: Adapted from Ugwu et al. (2021), modified by the author

According to Ugwu et al. (2021), a strong link between research paradigms and designs is critical in research, and selecting a particular research design should have a philosophical basis or paradigm on which the chosen method is anchored. In conducting a USSD technology adoption framework research, which is the main objective of this study, developing a framework that includes methodologies and a sequential methodical approach to completing the study is a requirement in scientific analysis (Vivek, 2022). The research paradigms and designs discussed in this section reiterate using quantitative, qualitative, or mixed methods to investigate factors that can improve USSD technology adoption for digital financial services in Nigeria. As scholars (Aalberg et al., 2012; Brannen, 2005; Lincoln, 2005) in IS research continue to bridge the gap between different paradigms and methods, other scholars in other scientific research have also embraced the pragmatism paradigm owing to its flexibility in mixing several paradigms and techniques (Said, 2023).

It has been established that pragmatism takes a pluralistic approach to address the research problem with what works and may combine other ideas and methods (Brannen, 2005; Doyle et al., 2009; Ugwu et al., 2021). Khatri (2020), in his remarks, proposed the use of pragmatism as a pluralistic approach to solving a research topic based on what works and the domain of interest. Additionally, without depending on metaphysical assumptions about ontology and epistemology, the pragmatism paradigm accounts for one of the most distinguishing elements of the previous paradigm—the significance of differentiating between post-positivism and constructivism (Ugwu et al., 2021). These are also illustrated in Figure 4.2.

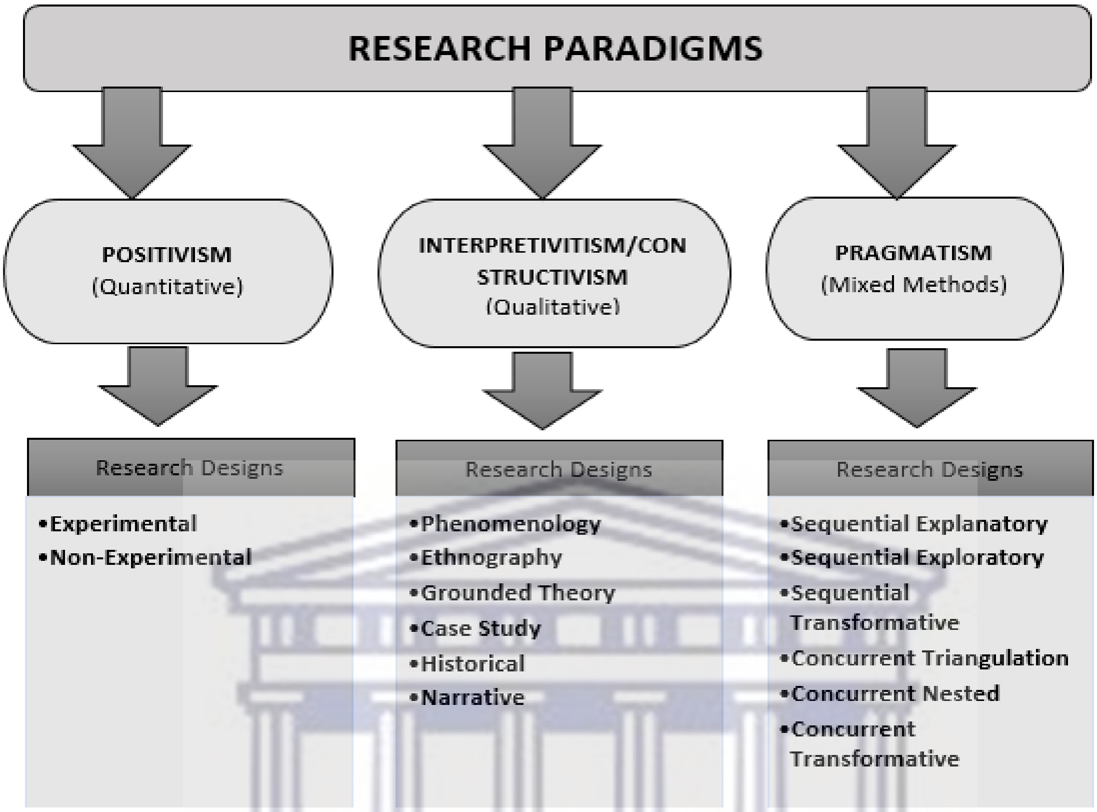


Figure 4.2: Diagrammatic Presentation of Research Paradigms and Designs Source: (Kumatongo, 2021)

Although the possibility of pursuing pragmatism as a paradigm for social research is not entirely new, its linkage with mixed-methods research (MMR) and its potential to replace the older philosophy of knowledge approach has heightened the awareness of pragmatism Said (2023) and Jokonya (2016) argued that pragmatism removes arguments about the nature of reality, and it is a crucial criterion for separating research techniques using a mix of empirical and theoretical foundations. Pragmatism has been widely recognised for its use in scientific research (Khatri, 2020), particularly in addressing research problems using mixed methodologies research techniques (Said, 2023). Consequently, several researchers have identified its appropriateness for conducting studies that need the integration of diverse data gathering and analysis methods to enhance the overall results of the research (Jokonya, 2016; Shan, 2022).

Khatri (2020) affirms that pragmatism is founded on the notion that no method is appropriate for understanding reality and developing knowledge (Khatri, 2020). In contrast to positivists and interpretivists, pragmatics are pluralists in that they do not adhere to a particular philosophical theory but use mixed designs to help researchers understand the phenomena they are studying (And &

Bougie, 2013). Pragmatism integrates quantitative and qualitative techniques and underpins the mixed-method philosophical paradigm (Creswell and Plano, 2011). This implies that pragmatism can serve as an epistemology for social research (Shan, 2022), regardless of whether that research uses qualitative, quantitative, or mixed methods (Khatri, 2020; Kumatongo, 2021). Based on these usability attributes, as opined by scholars (Forni & De Grande, 2020; Sivan, 2023; Toyon, 2021), using pragmatic-oriented mixed methods research helps to enrich the research outcomes.

With this philosophical background, the pragmatic approach was found suitable for investigating from a theoretical lens the factors that could stimulate and motivate the adoption and use of USSD technology for digital financial services within the Nigerian banking industry. In addition, based on the justification summarised in Table 4.1, this study employed the pragmatic philosophy, which helps to incorporate the findings on how USSD technology adoption can be improved to perform digital financial services in Nigeria from multiple perspectives into the discussion and conclusion.

4.3 Research Approach

According to Said (2023), a research approach provides the guiding principles for achieving a research objective. With the same scientific research understanding, Khatri (2020) described a research approach as a comprehensive plan from a philosophical worldview guiding the whole research activity. In scientific research, it is well-recognized that a research approach serves as the methodological framework that underpins how research questions would be addressed and procedures for achieving research goals (Turner, Cardinal, & Burton, 2017). To investigate factors to improve USSD technology adoption for digital financial services in Nigeria, the suitability of the pragmatic method for the study was established in section 4.2. Pragmatism emphasises a variety of methodologies (both objective and subjective knowledge) using qualitative and quantitative research questions in a single study (Hamilton, 2018; Shan, 2022; Theodorou, 2013).

As discussed in Chapter 2 of this study, factors to improve USSD technology adoption within Nigeria's dynamic digital financial services ecosystem are complex. Due to these complexities, a pragmatic research approach provides sufficient flexibility to quantitatively and qualitatively analyse factors to improve USSD technology adoption for DFS in Nigeria. Moreover, using the proposed USSD technology adoption framework to investigate issues associated with USSD technology adoption to perform digital financial services in Nigeria while providing recommendations towards adoption improvements based on findings of the research, pragmatism as a mixed-methods research technique was used because it helps to address research problems from both objective and subjective knowledge base. This aligns with the views of scholars (Monageng, 2023; Pashaie et al., 2023; Ramzan, 2023a) regarding the research domain in technology adoption and the use of behavioural decisions.

Owing to the complexities of the Nigerian digital financial services ecosystem discussed in Chapter 2 of the study, scholars (Pashaie et al., 2023) suggest that pragmatism is suitable for investigating complex technology adoption studies because it operates in a real-world environment with complicated social phenomena. The following section discusses the research strategy adopted for this study.

4.4 Research Strategy

Research strategy is vital for knowledge derivation (Jokonya, 2016). Past IS research focusing on mobile-based technology adoption proposes that a mixed-methods research strategy is most suitable because it embraces multiple perspectives in understanding the complexity of mobile-based technology adoption decisions (Hanouch & Chen, 2015; Idriss & Ajiya, 2022; Lim et al., 2016; Mallik et al., 2020a; Mogaji et al., 2020; Perlman & Wechsler, 2019a). To implement a research strategy suitable to derive outcomes from the proposed USSD technology adoption framework,
Monageng (2023) suggests that an appropriate research strategy is required to ensure the study's objective(s) are met and the study's research questions are answered using a multi-layered approach. To corroborate Monageng (2023), Ramzan (2023) also suggests that an appropriate research strategy using a methodological approach involving a defined philosophical framework would aid in eliciting different interpretations from participants, developing a deeper understanding of the data collected for analysis, and potentially producing theory or patterns of answers that may explain research data (Toyon, 2021)

Scholars (Monageng, 2023; Pashaie et al., 2023; Ramzan, 2023a) further emphasise that a mixed-methods research strategy is the most appropriate pragmatist philosophy when addressing research questions that require social behaviour and technology adoption investigations from several perspectives under a single study. Hamilton (2018) commented that mixed methods research techniques combine the results of qualitative and quantitative studies to give researchers more knowledge than separate analyses. Creamer (2017) suggests that mixed methods allow qualitative and quantitative techniques to meet at the middle of a methodological continuum, showing that their boundaries are closely tied. It counters purist claims that qualitative and quantitative methods are too distinct to mix (Said, 2023). Doyle et al. (2009) posit that mixed methods allow the investigator to collect and analyse data, integrate the findings, and draw inferences using qualitative and quantitative approaches or methods in a single study.

Based on the aforementioned, scholars argue that mixed-methods research should be considered for a study to provide a 'more accurate and adequate understanding' of the research problem in question than would have been possible using quantitative or qualitative data alone (Bans-Akutey & Tiimub, 2021). The following section discusses the mixed methods research strategy in more detail.

4.5 Mixed-Method Research Strategy

As previously stated, mixed-methods is often regarded as a research technique that combines qualitative and quantitative methodologies within a single study. As Gunasekare (2015) cited, the period from 1900 to 1950 was a significant milestone in the history of qualitative research. Subsequently, in the 1960s, amalgamating the methodologies above was proposed (Gunasekare, 2015). Theodorou (2013) also shares that by the beginning of the 1990s, support for mixed methods increased as quantitative and qualitative methods' contribution to complex research problems in behavioural sciences became more evident, and the number of mixed methods studies increased. Due to its flexibility for an interdisciplinary approach in academic research, O'Cathain (2010) also mentioned that mixed methods research allows working with different data types, investigators, or research teams in various research paradigms.

According to Said (2023), the inception of this movement may be traced back to the 1980s, when sociologists tried to reconcile the discord between the qualitative and quantitative paradigms by amalgamating them into a novel approach. In recent years, there have been several iterations or stages in developing research methodology. During the 19th century, the quantitative research paradigm, including several forms of quantitative research designs, emerged as the primary and exclusive option of research design across numerous fields (Gunasekare, 2015). During the transition from the 19th to the 20th century, a subset of researchers began to reject the underlying assumptions and ideas of the quantitative paradigm, leading them to adopt the qualitative research paradigm (Forni & De Grande, 2020; Monageng, 2023; Sivan, 2023). According to Gunasekare (2015), mixed method studies have garnered significant attention from scholars in the broad area of social science research, they have labelled it as a third paradigm in the evaluation and conducting of research.

For these reasons, a mixed-method study is often called a multi-strategy research approach (Brannen, 2005). This also aligns with the views of Creswell et al. (2011), who opined that mixed methods help an investigator to combine statistical trends (quantitative data) with stories and personal experiences (qualitative data) to provide a better understanding of the research problem than either form of data alone. Scholars (Creswell and Plano, 2011; Morgan, 2007) further explained the mixed methods research approach as mixing or integrating qualitative and quantitative methods, data collection, and analysis in a single study to understand the research problem better. The extent and depth of these definitions vary, but almost all relate to some type of fusion of qualitative and quantitative research methodologies (Namey, Guest, & Fleming, 2023). From philosophical assumptions, mixed-methods research enables mixing of quantitative and qualitative approaches throughout the research process (Hanson et al., 2005).

According to Toyon (2021), mixed-methods research is not commonly adopted by researchers studying technology adoption behaviour despite its benefits to research in this area. Mixed-methods have been generally associated with social sciences (Maforah & Leburu-Masigo, 2018). However, this emergent methodology is being increasingly applied in disciplines traditionally associated with a mix of quantitative research and qualitative research techniques (Adela, 2022; Said, 2023; Vivek, 2022), including in USSD technology adoption research (Shan, 2022). Beginning since the 19th century, mixed methods research has become more prevalent in many disciplines, including spots management (Pashaie et al., 2023), health sciences and Covid-19 impact analysis (Sivan, 2023), socio-economic analysis and tax compliance review (Monageng, 2023), banking services and digital financial inclusion (Adela, 2022), the impact of educational programs (Kadushin, Hecht, Sasson, & Saxe, 2008), archaeology and language adaptation assessment (Bans-Akutey & Tiimub, 2021) and academic research (Ramzan, 2023a).

Mixed-methods research, often known as the 'third methodological orientation' (Monageng, 2023; Pashaie et al., 2023), capitalises on the merits of both quantitative and qualitative research approaches (Berman, 2017). O'Cathan (2010) uses a mixed-methods research strategy to elicit randomised controlled trials to assess the effectiveness of survey instruments and semi-structured interviews. In adopting mixed-methods for scientific research, scholars (Turner et al., 2017) argued that all methods are flawed, but these limitations are mitigated through mixed-methods research, which combines methodologies to provide better answers to research questions. This is consistent with the views of interdisciplinary researchers (Pashaie et al., 2023; Ramzan, 2023b; Toyon, 2021) who adapted mixed methods earlier and argued that mixed methods are not simply the combination of methods and types of data (Le & Ngo, 2020), but a different way of knowing or making sense of data collected and analysed in research (Pant, 2018).

There have been many use cases of mixed-methods in industry research. For instance, Pant (2018) adopted a mixed-method research strategy to design and develop a visual and conceptual modelling language for representing and reasoning about strategic co-opetition. Also, Le & Ngo (2020) used a mixed-method approach to investigate and determine bank profitability using cross-country analysis.

Many more researchers have also adopted mixed-methods in their various fields of research, and as mixed-methods research strategies are being increasingly employed, researchers have started pointing out the parallels between qualitative and quantitative techniques (Jokonya, 2016; Kelly & Palaniappan, 2022; O'Cathain, 2010). An investigator using mixed-methods research collects and analyses data, integrates findings, and draws conclusions using qualitative and quantitative methods in a single study or inquiry program.

This means researchers do not limit themselves to a limited range of conventional research methods (Brannen, 2005). From a qualitative and quantitative data integration perspective and as discussed in section 4.4, mixed-methods is a research strategy employing a mix of qualitative and quantitative methods to examine different aspects of an overall research question (Sivan, 2023). As cited in Monageng (2023), dedicated international seminars and workshops have also been devoted to discussing mixed methods research. This has also drawn the attention of the International Journal of Social Research Methodology, which reveals a surge in the use of mixed-methods study in social science research from the beginning of the 20th century (Brannen, 2005). In addition, the number of papers with "mixed methods" in the title or introduction has risen sharply in the past twenty years (Hamilton, 2018; Shan, 2022). These assertions imply that mixed methods research is emerging as a dominant paradigm in scientific research.

However, the continuous use of mixed-methods in social science research has also come with mixed reactions that the distinction between qualitative "purists" and quantitative "purists" was overblown (Shan, 2022). In their own remarks, Creswell and Plano (2011) argued that, as research in social science grew and continued to evolve, scholars began debating issues around quantitative methods and started exploring the use of mixed-methods. The philosophy of pragmatism consequently advanced the usability of mixed methods as it advocates eclecticism and a needs-based or contingency approach to research method and concept selection' (Doyle et al., 2009). Despite the necessity for IS research to bridge the gap between distinct paradigms and methodologies, researchers opined that no absolute mixed methods recommendations were offered within the IS field's evolving paradigms within a single study (Venkatesh, Brown, 2016).

In response to this need, Venkatesh et al. (2016) developed a set of guidelines for conducting mixed-methods research and illustrated the applicability of these guidelines. As depicted in Figure 4.3, Creswell & Plano (2011) described the required elements to design and conduct mixed methods research. The convergent design element indicates the mode of data collection and analysis to derive an interpretation for the research objectives concurrently.

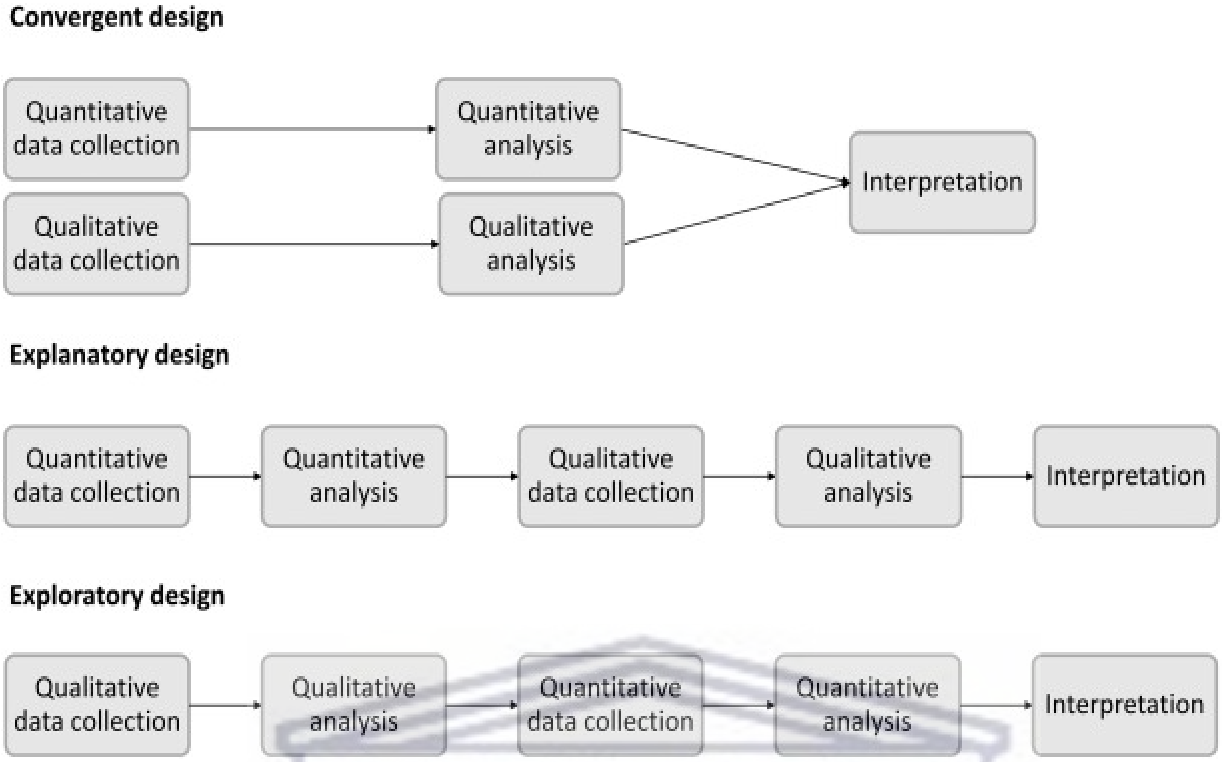


Figure 4.3: Designing and Conducting Mixed Methods Research (Creswell & Plano, 2011)

As discussed in previous sections of the study, research has shown that mixed-methods allow both qualitative and quantitative techniques to complement each other. Based on these philosophical assumptions, Creswell & Plano (2011) further present two types of complementary data collection and analysis that could be undertaken under a single research. Furthermore, Creswell et al. (2011) also extrapolate what a mixed-methods research strategy is not for a better understanding of its usability, summarised in Table 4.2. A commitment to this viewpoint is founded on the assumption that restricting a mixed methods style of thinking to one stage of the research process does not maximize the potential value-added of mixed methods (Kumatongo, 2021).

Table 4.2: What Mixed-Method is Not

#	View	Description
1	Data combination	Mixed-methods are not simply the gathering of both quantitative and qualitative data. The combination of the two data sets plays upon the strength that this combination brings to a study.
2	Not a study label	Mixed-methods research should not be used as a label in a research study since specific scientific techniques associated with this methodology gain the reviewer's attention.

3	Not to be confused with a mixed model.	Mixed-methods should not be confused with a mixed model approach to quantitative research, in which investigators conduct statistical analysis of fixed and random effects in a database.
4	Not an evaluation technique	Mixed-methods are not simply an evaluation technique, such as formative plus summative evaluation, even though a researcher could collect and integrate quantitative and qualitative data.
5	Not the addition of qualitative data to a quantitative design	Mixed-methods are not simply the addition of qualitative data to a quantitative method.
6	Not a collection of multiple data sources	Mixed-methods cannot be described as the simple collection of multiple forms of qualitative data (e.g., interviews and observations), nor the collection of various types of quantitative data (e.g., survey data, experimental data).

Source: Designing and Conducting Mixed Methods Research (Creswell et al., 2011))

Similarly, Maforah & Leburu-Masigo (2018) argued that mixed-methods research does not use a linear approach but provides a 'more accurate and adequate understanding' of the research problem in question than would have been possible using quantitative or qualitative data alone. As a logic of inquiry, Hamilton (2018) opined that the fully integrated mixed methods research approach sets qualitative and quantitative techniques as distinct but equally acceptable means of knowing and comprehending complex social phenomena. Although philosophical assumptions influence the study inquiry at a higher level in mixed methods research, Maforah & Leburu-Masigo (2018) mentioned that mixed methods research helps to overcome the restriction of understanding the study topic with a single approach design (Hamilton, 2018). The intention is to mix or integrate the qualitative and quantitative strands of study throughout each stage or phase of the research process (Creamer, 2017).

Regarding its efficacy in academic research, the literature submits that mixed methods are used to weave together qualitative and quantitative strategies throughout a study's five phases or stages (Khatri, 2020; Kumatongo, 2021; Ugwu et al., 2021). It is a systematic process of completing a research study using mixed data sets as informed by the research in focus (Hamilton, 2018; Shan, 2022). This aligns with the views of other scientific researchers who posit that the study question, aims, context and circumstances of the phenomena are the drivers for using mixed methods across the stages of the research (Toyon, 2021). As discussed in sections 4.3 and 4.4, the suitability of a mixed-methods research strategy is appropriate for investigating the USSD technology adoption framework. It combines quantitative and qualitative research techniques to address the research problem and complexities inherent in the factors to improve USSD technology adoption to perform digital financial services in Nigeria.

This also aligns with the views of Sivan (2023), who suggests that mixed-methods research provides evaluation techniques to engage different viewpoints with a highly compatible mixed-method way of technology adoption thinking.

4.5.1 Rationale for Using Mixed-Methods

As summarised in Table 2.8, past research focused on USSD Technology Adoption in Nigeria's DFS ecosystem adopted a mix of single-method and mixed-method research strategies. Drawbacks of the single-method research strategy include a narrow view of analysis and approach underpinning the study's theoretical framework (Igwenagu, 2017), knowledge limitation which will not enrich the study's outcome (Doyle et al., 2009), inaccurate and inadequate understanding of the research problem in question than would have been possible using quantitative or qualitative data alone (Hamilton, 2018). Others include the limited opportunity for data collection, analysis, and integration of the findings to draw inferences from multiple perspectives in a single study (Said, 2023; Sivan, 2023; Vivek, 2022). To further justify using mixed methods for investigating this study's USSD technology adoption framework, Turner et al. (2017) suggest that the generalisability, precision in control, and measurement of data sets collected from different world views provide authenticity of its context.

In addition, the justification for adopting mixed-methods for this study also aligns with the views of scholars (Macharia et al., 2022; Ramtiyal et al., 2022; Shakya, 2022) who allude to the fact in scientific research focusing on mobile technology adoption, mixed methods have been identified as a preferred research strategy because they support a combination of qualitative and quantitative data as part of adductive reasoning (approaches that involve deductive and inductive reasoning, respectively). More importantly, Toyon (2021) opined that a mixed-methods research strategy promotes theoretical and empirical verification, fostering intersubjectivity in understanding shared outcomes of the study (either qualitative or quantitative or a mix of both). Said (2023) states, "Mixed-methods research incorporates the blending of qualitative and quantitative methodologies in the collecting and interpreting data." Because it combines the reliability of counts with the validity of lived experience and perception (qualitative and quantitative approaches, respectively), mixed methods research provides a better understanding of research problems (Kumatongo, 2021).

As cited in previous literature, one of the main arguments in favour of mixed methods research is that it makes up for the drawbacks of both qualitative and quantitative approaches (Maforah & Leburu-Masigo, 2018). In this study's proposed USSD technology adoption framework, constructs of the framework were investigated using a mix of intangible and tangible factors in USSD technology adoption decision-making. This provides the basis for adopting a mixed methods research approach to enable the research outcome with elements of both intangible and tangible factors without bias. Research has shown that using mixed methods research helps to overcome the restriction of understanding USSD technology adoption decision-making using a single-method design. As discussed in sections 2.4 and 2.5 in chapter 2 of this study, USSD technology is a systematically important channel in the Nigerian digital financial services ecosystem with oversight from two key regulators (the Central Bank of Nigeria and the Nigerian Telecommunication Commission).

As discussed in Chapter 2 of the study, Nigeria is already at an inflection point of digital financial inclusion using USSD technology to access almost all digital financial services and a co-opetitive strategy is required by relevant stakeholders to advance this agenda. In this context, mixed-methods research ensures the credibility of the USSD technology adoption framework validation outcomes by engaging relevant stakeholders to give subject matter opinions to validate the quantitative data. On these bases, in the investigation of the proposed USSD technology adoption framework for digital financial services in Nigeria, mixed-methods research was used for the study because it produces more comprehensive and fuller data on improving USSD technology adoption decision-making within a complex digital financial service ecosystem which comprises of multiple regulatory interests and large population of institutions licensed to provide USSD technology based digital financial services.

From a philosophical point of view to address the study's objectives, scholars (Monageng, 2023; Toyon, 2021; Vivek, 2022) believe that various positions can be employed to provide philosophical foundations of mixed methods research. Furthermore, mixed methods research rationale has become more prevalent in addressing complicated research problems and delivering more in-depth knowledge in IS research (Said, 2023; Younas, Fàbregues, & Creswell, 2023). To achieve a robust research design through a procedure for collecting, analysing, and mixing or integrating quantitative and qualitative data at some stage of the research process within a single study, previous literature (Adela, 2022; Monageng, 2023; Said, 2023; Sivan, 2023; Vivek, 2022) suggest that mixed-methods research attributes provide the required justification and rationale to quantitatively and qualitatively investigate factors to improve USSD technology adoption for digital financial services in Nigeria. According to Hamilton (2018), some of these attributes are summarised in Table 4.3.

Table 4.3: Rationale for Using Mixed-Method

#	Rationale	Description
1	**Complementarity**	Mixed-methods research enables academics to address topics that cannot be solved with a single approach. It generally allows researchers to acquire a more thorough knowledge of a phenomenon by combining quantitative and qualitative methodologies.
2	**Triangulation**	Mixed-methods allow researchers to cross-validate their findings by comparing quantitative and qualitative results, boosting their conclusions' overall validity and dependability.
3	**Expansion**	Another advantage of mixed-methods research is that it allows you to broaden your investigation area. Researchers may investigate and study several aspects of a phenomenon from various angles using diverse approaches. This method may assist researchers in uncovering unexpected data and developing new theoretical ideas.
4	**Initiation**	A combination of qualitative and quantitative methods are used as separate lenses for examining a research problem – looking for contradictions and stimulating new thinking.
5	**Complexity Examination**	Mixed methods research is especially beneficial for examining complicated phenomena that cannot be comprehended entirely with a single approach.

Source: Mixed-methods research: Achieving a robust design (Hamilton, 2018)

Following the mixed-methods research attributes summarised in Table 4.3, this study adopts triangulation as one of the mixed-methods rationales outlined by Hamilton (2018). As a fundamental concept in the social sciences, triangulation involves using diverse and varied perspectives to generate a better understanding of a given theory or phenomenon (Turner et al., 2017). Early work in the social sciences focused on the role of triangulation in measurement, which involves employing different methods to evaluate the validity of a research construct (Kadushin et al., 2008; Ramzan, 2023b). Hamilton (2018) suggests that triangulation of results allows the cross-validation of factors by comparing quantitative and qualitative results under a single, which boots the conclusions' overall validity and dependability. Furthermore, this study's choice of triangulation for investigating the proposed USSD technology adoption framework in Nigeria is predicated on the views of other researchers (Pashaie et al., 2023; Said, 2023; Turner et al., 2017) who opined that triangulation allows for explicitly identifying disagreements between findings from different methods under a single research.

Although different findings under a single research or using different data analysis techniques to derive results that are not congruent or might disagree with results are expected in academic research based on varying factors, O'Cathian (2010) and Turner et al. (2017) suggest that disagreement is not a sign that something is wrong rather, it allows a better understanding of the research question with separate data collection and analysis procedures to complement research findings. According to Jokonya (2016), triangulation enables the integration of quantitative and qualitative results. Similarly, Venkatesh et al. (2013) emphasise the importance of triangulation, which allows quantitative and qualitative research results from different research approaches to be cross-examined to enrich research outcomes (Monageng, 2023).

Based on the views of other scholars (Turner et al., 2017) on the choice of triangulation, the mixing of qualitative (in-depth interviews) and quantitative (use of questionnaire/s) in this study ensures completeness of the study's results and in making better inferences about how elements of the proposed USSD adoption framework - the Stimulus (features and capability of USSD technology – design, security, information quality, and system quality) effects the Organism (motivation to use USSD technology- user experience, perceived usefulness, perceived risk, and perceived trust) and the effects on and Respond (adoption and usage of USSD technology- consumer intention to use USSD technology for digital financial services and user satisfaction) for digital financial services in Nigeria from both consumers and subject matter experts in the banking industry. Triangulation's key benefit is enriching the research outcome (Turner et al., 2017).

This allows researchers to investigate a phenomenon from different world views because of the mixed quantitative and qualitative research capability. These often lead to a more, robust and valuable conclusions (Ndlovu and Siyavora, 2014; Gnyawali, Madhavan, He, & Bengtsson; 2016). Mixed-methods research benefits also come with criticism of its usage in research. This will be discussed in the next section.

4.5.2 Mixed-Methods Research Criticism

Despite the justification of mixed method suitability for this study, as discussed in section 4.5.1, the belief in mixed-methods research design amongst academics identifying as qualitative or quantitative researchers has also been contentious. More contemporary writings in this area sought to understand the importance of complete integration of the two approaches (quantitative and qualitative) compared to the use of a single method (quantitative or qualitative) (Brannen, 2005; Creswell and Plano, 2011; Doyle et al., 2009; Ugwu et al., 2021). Due to these multi-sided perspectives on using mixed methods in scientific research, Brannen (2005) suggests that mixed-methods have been characterised by misunderstandings regarding the challenge of using qualitative or quantitative analysis. For example, from a statistical generalisation standpoint, quantitative researchers have seen qualitative researchers as being too context-specific, having unrepresentative samples, and making unjustified assertions about their work (Kumatongo, 2021).

According to qualitative researchers, quantitative research is oversimplified, decontextualized, reductionist in generalisations, and fails to reflect individuals' meanings of their situations and lives (Brannen, 2005). Also, Brannen (2005) opined that the different presentational modes in two languages (quantitative and qualitative) might sit awkwardly on the page. Creswell (2007) believes that difficulties with mixed-methods often arise when the researcher attempts to articulate how the two elements relate. This eventually results in an incompatibility thesis with the challenge of integrating techniques from different paradigms (Doyle et al., 2009). Recently, there has been an increased focus on the significance of triangulation in enhancing our comprehension in the broader context.

Mixed methods research is founded on the concept of achieving a more profound understanding through the use of methodological triangulation (Vivek, 2022). While scholars continue to prove the efficacy of integrating research methods from different paradigms, Lincoln (2005) opined that those who do not endorse pragmatism completely have influenced the complementary strength thesis. The complementary hypothesis states that it is possible to have mixed methods research, but the different components must be kept separate to realize their strengths (Theodorou, 2013). Brannen (2005) and Creswell (2007) argue that as mixed methods research evolves by drawing interpretations based on the combined strengths of qualitative and quantitative data to understand research problems, the discussion of what it should be will continue to be a debate among scholars. From a consistency point of view, the consistency of mixed methods has also been criticised by various scholars.

Creswell et al. (2011) opined that researchers are inconsistent in articulating quantitative and qualitative research elements under a single study. Other researchers (And & Bougie, 2013) opined that a mixed methods approach complicates the research design and, therefore, requires a clear presentation to allow the reader to sort out its different components. Despite these criticisms, the choice of mixed-method for this study ultimately corroborates the data, considering the complexities of the constructs in the USSD technology adoption framework for this study. Thus, quantitative data collected from customers of banks using USSD technology to perform digital financial services are checked and verified by qualitative data collected from subject matter experts in the banking industry and vice versa. From a risk perspective of cross-examining macro-level data using mixed-methods research, Brannen (2005) suggests such macro-level data requires context mapping exercises involving secondary analysis with more intensive research approaches that address the micro level, which cannot be addressed using mixed-methods.

As discussed in the previous section, mixed methods is the research technique adopted for this study. Mixed methods research encompasses a variety of methodological traditions and approaches (Gunasekare, 2015), resulting in differences in data collection techniques, data processing and analysis methods, and the generation and validation of conclusions (Toyon, 2021). Without a comprehensive understanding of the phases involved, the contribution towards the progress of research and the promotion of awareness about the existing issues may be diminished and may result in the discovery of paradoxes and contradictions.

However, according to Gunasekare (2015), Creswell's book "Research Design: Qualitative and Quantitative Approach" describes six mixed methods research strategies that can be used in research. They are: 1. Sequential Explanatory Mixed Method collects and analyses quantitative data followed by a collection and analysis of qualitative data to use qualitative results to assist in explaining and interpreting the findings of a quantitative study. 2. Sequential Exploratory Mixed Method is an initial phase of qualitative data collection and analysis followed by quantitative data collection and analysis to explore a phenomenon. 3. The Sequential Transformative Mixed Method is a collection and analysis of either quantitative or qualitative data first; then, the results are integrated into the interpretation phase to employ the methods that best serve a theoretical perspective. 4. Concurrent Triangulation Mixed Method uses two or more methods to confirm, cross-validate, or corroborate findings within a study. Using the approach, data collection is concurrent, and it is generally used to overcome a weakness in using one method with the strengths of another. 5. Concurrent Nested Mixed Method which includes a nested approach that gives priority to one of the methods and guides the project, while another is embedded or "nested." 6. Concurrent Transformative Mixed Method is the design that uses a theoretical perspective reflected in the purpose or research questions of the study to guide all methodological choices to evaluate a theoretical perspective at different levels of analysis.

To investigate the USSD technology adoption framework proposed in this study, sequential explanatory mixed methods were used because it allows for a general understanding of the research problem to be gained through the use of quantitative data, which is then followed by the ability to validate the dependability of statistical results through the use of the qualitative method, sequentially (Creswell and Plano Clark, 2011).

4.5.3 Sequential Explanatory Mixed-Method

This study used a sequential explanatory mixed methods design to investigate further the proposed framework to improve USSD technology adoption for digital financial services in Nigeria. According to Theodoru (2013), the sequential explanatory mixed-method is a two-phase strategy that places the collection and analysis of quantitative data first, followed by the gathering and analysis of qualitative data. Popularly used in research with diverse data sources, research requires a multidisciplinary approach and complex variables to achieve the research objectives (Hamilton, 2018; Theodorou, 2013). Furthermore, the sequential explanatory mixed method is a research strategy that involves collecting and analysing quantitative data first, followed by qualitative data sequentially. This sequential data collection and analysis aims to explain the confluence of the outcome of investigating a research problem in greater depth (Ugwu et al., 2021). Ivankova et al. (2006) reconceptualised sequential explanatory mixed methods for critical realism.

The researchers have embraced a six-stage explanatory paradigm incorporating abductive and retroductive reasoning modes. Abductive analysis is a method that involves the theoretical reinterpretation of facts, whereas retroduction is a reasoning process aimed at deriving fundamental principles to enhance research analysis. Research designs based on sequential explanatory mixed methods allow for a general understanding of the research problem to be gained through the use of quantitative data, which is then followed by the ability to validate the dependability of statistical results through the use of the qualitative method, sequentially (Toyon, 2021). Hamilton (2018) also suggests that sequential explanatory mixed methods help to understand the complex phenomenon of the research objectives from multi-sided perspectives by using findings from the quantitative study to inform the qualitative research.

According to Jokonya (2016), the justification for sequential explanatory mixed-method research strategy aligns with a pragmatic philosophy, emphasising the importance of using multiple research methods and techniques to address complex problems in real-world contexts (Hamilton, 2018). For the investigation of the proposed USSD adoption framework, the motivation for sequential explanatory mixed methods is to leverage the quantitative results of the correlation of features and capabilities of USSD technology, how they impact consumer's motivation to use USSD technology for digital financial services, and then validate the results of the quantitative from the quantitative phase to and add richness to the overall study outcome. The continued discussion on the suitability of sequential explanatory mixed-methods for this study also aligns with the views of some IS researchers (Ivankova et al., 2006; Maforah & Leburu-Masigo, 2018; Toyon, 2021) who argued that sequential design is a beneficial tool where a single approach may not be enough to deliver definitive findings on the study field.

As shown in Figure 4.3, a sequential explanatory mixed-methods design is most suitable for this study. The first phase is the quantitative data collection using standard structured data collection methods and statistical analysis of constructs of the proposed USSD technology adoption framework to determine the correlation of variables in the proposed framework to improve the USSD technology adoption for digital financial services. This phase aims to empirically establish general patterns or trends related to the research problem. The qualitative research phase follows. Based on the results of the quantitative phase, a semi-structured interview guide was developed to elicit information from subject matter experts within the Nigerian banking industry and to validate the results obtained in the quantitative phase. This phase (qualitative) explored the underlying reasons and contexts that explain the patterns or trends identified in the first data analysis phase (quantitative).

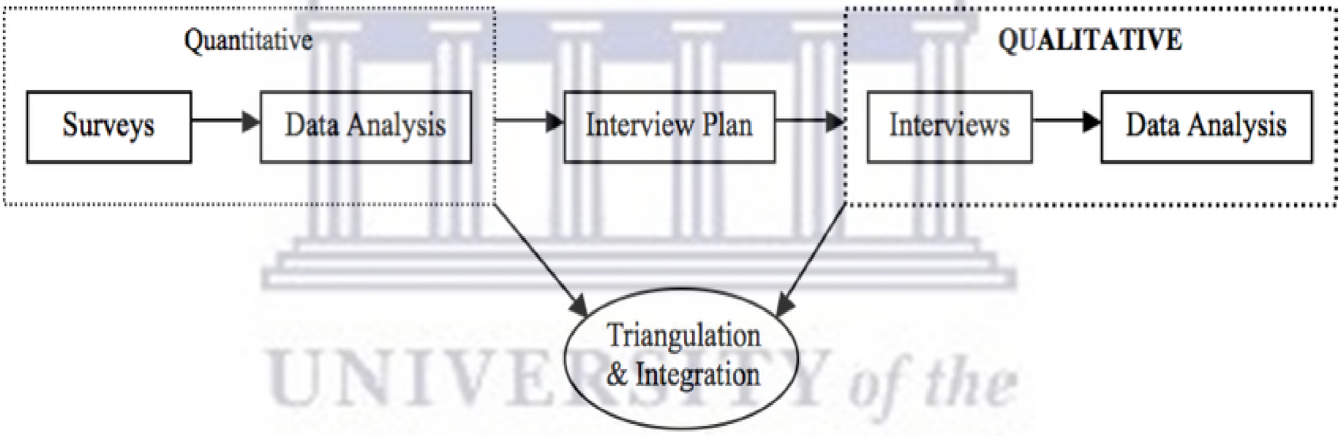


Figure 4.3. Sequential Explanatory Mixed Methods Design (Venkatesh et al., 2013)

After examining and discussing the appropriateness of using a sequential explanatory mixed-method technique for the present study, the subsequent section explains the quantitative data collection and analysis approach, followed by an account of the qualitative data collection and analysis methods.

4.6. Quantitative Data Collection Phase

Quantitative data analysis is a methodical approach to research that involves collecting numerical data and transforming it into numerical data throughout the study (Adela, 2022; Monageng, 2023). According to Adela (2022), the quantitative data collection phase entails gathering relevant information from a person or group to describe, compare, or explain their knowledge, attitudes, and behaviour about a phenomenon. Similarly, Babbie (2008) suggests that standard data collection methods like surveys can be used for descriptive, explanatory, and exploratory purposes. In other words, a survey may take on a variety of formats, such as a questionnaire or an interview, allowing respondents to do the questionnaire at their own time and speed (Babbie, 2008). As a step in conducting research, academic researchers must make informed decisions on the selection of data collecting tools that align with their aims, while considering the research topic, theoretical framework, and the process of triangulation.

In other words, scholars should select their data collection instruments following their identification of the research methodology (Turner et al., 2017). Having discussed the research methodology adopted for this study, this section explains the mode of quantitative data collection, sampling size, data validity, and reliability approach based on the constructs of the proposed USSD technology adoption framework.

4.6.1 Research Instrument

The survey approach is widespread in Information Systems (IS) research due to its ability to facilitate the collection of data pertaining to several research inquiries. Surveys are often used in exploratory and descriptive analyses to gather data about individuals, occurrences, or circumstances. Questionnaires are most useful as a data collection method, especially when large numbers of people are to be reached in different geographical regions. They are a popular method of collecting data because researchers can obtain information reasonably quickly, and the questionnaire responses are efficiently coded. A research questionnaire written in a question-and-answer format was the data collection instrument for the study. Questions in survey instruments are typically arranged into self-administered questionnaires that a respondent completes on their own, either on paper or online.

The study used constructs of the proposed USSD technology adoption framework to develop the questionnaire for the quantitative phase. These include Stimulus (features and capability of USSD technology – design, security, information quality, and system quality), Organism (motivation to use USSD technology- user experience, perceived usefulness, perceived risk, and perceived trust), and Respond (adoption and usage of USSD technology- consumer intention to use USSD technology for digital financial services and user satisfaction). The questions were closed-ended questions with pre-determined answer alternatives. The questionnaire was divided into three components to answer the research questions on factors to improve USSD technology adoption for digital financial services in Nigeria. The sections collected information on are (i) current challenges of using USSD technology for digital financial services in Nigeria, (ii) ways in which these current challenges can be addressed, (iii) the impact of stimulus factors (features and capabilities of the USSD technology) and organism factors (motivating factors for using USSD technology) on the adoption and use of USSD technology. The sample quantitative data collection instrument is in Appendix I.

In addition, the questionnaire was developed using a Likert scale with 1 = strongly disagree and 5 = strongly agree. The questionnaire was pretested with a few respondents to improve the quality. Questionnaires were administered via Google form in addition to printed copies for those who could not have online access.

4.6.2 Data Sampling Method and Size

The probability random sampling method was used for the study. According to data from the Industry Account Database (ICAD), which the Nigeria Interbank Settlement System Plc maintains, the estimated active and unique bank account holders spread across banks licensed by the CBN as of December 2021 is about 98,000,000. A minimum sampling size of 400 was determined using the acceptable margin error of 5%, the most significant difference between the observed sample mean and the actual population mean value, and the 95% confidence interval, which is an acceptable margin of error based on the views of Kumar (2011). To generate the sample size calculator, the RAOSOFT statistical software was used. This allows the researcher to estimate the sample size based on the margin of error within the population (Kumar, 2011). Respondents to be interviewed were distributed among the top ten banks, contributing over 90% of Nigeria's retail payments volume over five years (2015 -2020).

This provides the study with a sample that is highly representative of the population that is being researched. Selected banks have branches all over Nigeria, with their head offices in the economic capital of Nigeria. Due to time constraints and other limitations, the selection of at least 400 respondents for the quantitative analysis was accomplished by using random sampling. This method ensured that every conceivable sample picked had a preset chance of being chosen (Creswell and Plano, 2011).

4.6.3 Data Collection Method

Upon receiving ethical approval from the University of the Western Cape, questionnaires were disseminated using both paper and the Google form application to elicit information from respondents regarding the factors that could stimulate and motivate the adoption and use of USSD technology for digital financial services in Nigeria. The study was conducted across five states in Nigeria, including Lagos State, where 98% of banks, MNOs, and other DFS ecosystem players' head offices are located.

To access primary data sets on ICAD for the quantitative research to baseline the sample size and also access transaction volume from mobile-enabled channels, prior approval to access the data for mobile payments and bank account distribution (without the details of the account, such as account name or account holders address) within the Nigerian banking industry was sought from the management of Nigeria Interbank Settlement System plc (NIBSS) (Appendix IV).

This was done to fulfil the research requirements. Proof of acceptance to grant access to primary data on the condition of anonymity of participants and institutions with strict compliance to the primary purpose of the intended usage was provided in a letter response from NIBSS. In addition, a sample consent letter to ensure respondents accepted to participate in the survey (Appendix V) voluntarily was submitted to the University of Western Cape, and the university's ethical approval was given before starting the data collection process. Questionnaires are often associated with poor response rates since individuals usually neglect to submit them, which reduces the sample size (Kumar, 2011). Data sampling requirements stipulate a minimum sampling size of 400 based on the acceptable margin error of 5%. Based on these suggestions, about six hundred respondents were contacted with questionnaires and targeted emails to increase the respondent's response rate from the minimum baseline.

This implies that the study was oversampled. Oversampling is a research technique that deliberately increases the number of participants from a particular subgroup or population to ensure sufficient representation for that group in the sample (Wongvorachan, He, & Bulut, 2023). It is used to manage the imbalance of data sets in research (Alothman, AliTalib, & Mohammed, 2022). In other words, oversampling involves intentionally selecting a more significant proportion of participants from a specific subgroup or population than would be present in the general population. This is often done to ensure enough participants from underrepresented groups for meaningful analysis and conclusions (Wongvorachan et al., 2023). Although the data collection duration was delayed and took longer than anticipated (due to the impact of COVID-19, which restricted face-to-face interactions), it took five months behind schedule before commencing the data collection activity (from February 2021 to June 2021).

After completing the first phase of data collection, which consisted of administering questionnaires, the data were coded and analysed to produce preliminary results, which played an essential role in informing the second phase of the sequential explanatory mixed methods, which consisted of qualitative interviews. There was a gap of two months between the end of the quantitative data collection and the start of the qualitative activities.

4.6.4 Data Reliability and Validity

In research, the validity test is the level to which the measuring or research instrument accurately and effectively measures what it is intended to measure. The validity test aims to find out if there are statements on the questionnaire that must be replaced because they are considered invalid (Sovania & Erasashanti, 2020). Researchers must establish the appropriateness, quality, and accuracy of the procedures adopted to find answers to the research questions. Broadly, this concept of appropriateness and accuracy is called validity as applied to a research process (Kumar, 2011). According to Kumar (2011), there are three types of validity in quantitative research: face and content validity, concurrent and predictive validity, and construct validity. Each question or item on the research instrument must link logically with an objective. Establishing this link is called face validity. According to scholars (Toyon, 2021; Younas et al., 2023), face validity allows the conclusion that an instrument measures what it should, based primarily on the logical link between the questions and the study's objectives.

As a result, one of the main advantages of this type of validity is that it is simple to apply (Kumar, 2011). Similarly, face validity determines whether a test measures what the researchers intended (Clark & Watson, 1995). The concept of reliability in a research instrument is of great importance. A research instrument is deemed reliable if it is consistent, stable, predictable, and accurate. The greater an instrument's consistency and stability, the greater its dependability (Kumar, 2011). The study adopted face validation to assess the quantitative reliability and validity of the components included in the study framework. A few respondents and the researchers' colleagues were engaged in validating the representation of various constructs in the research instrument and determining how they would address the research questions. Face validation aims to discover any visible or apparent flaws with the measure or questionnaire content that may impair its validity (Olaolu, 2022).

The researcher ensured that the data collection instrument was void of ambiguity or irrelevance and suitable for the population targeted for data collection. This was done before dispatching the questionnaires for completion. In addition, the independent variables of the framework were turned into questionnaire items in the proposed research, and the level of their significance was tested for a satisfactory level of reliability, the consistency of constructs, and the fitness of the data with the hypothesised measurement model using Kaiser-Meyer-Olin (KMO) and Bartlett's test analysis (also used in substitution for confirmatory factor analysis (CFA)).

4.6.5 Quantitative Data Analysis

After receiving responses to the survey to investigate the proposed USSD technology adoption framework, data clean-up was done, and because of this, the data's accuracy, consistency, correctness, and completeness were assured. Data from the questionnaire developed for the proposed framework were normalised and captured in the statistical software application package (SPSS -Statistical Software for Social Scientists) for analysis. A variance inflation factor (VIF) analysis was performed on the variables to measure the amount of multicollinearity. Multicollinearity exists when there is a correlation between multiple independent variables in a multiple regression model. The model significance test results for all the models were significant ($p<0.05$), as presented in Chapter 5 of the study. By implication, the regression models captured the relationship between the dependent variable in the case of the adoption of the USSD technology and the independent variables (stimulus factors and organism factors).

After finishing the quantitative data analysis, the results obtained from the quantitative research component were analysed in preparation for the qualitative interview.

4.7 Qualitative Research Method

Qualitative research is more exploratory, acquiring insight into reasons, beliefs, views, and motives by combining research results and knowledge base from subject matter experts within areas of research interest (Creamer, 2017). Within behavioural sciences research, qualitative research is centred on elucidating and comprehending the human cognitive approach to analysing societal issues. In qualitative research, the process begins with formulating research questions and continues with developing methods for gathering sources of evidence from participants, followed by data analysis and interpreting what the findings indicate. Inducted in the behavioural sciences, qualitative research is centred on elucidating and comprehending the human cognitive approach to analysing societal issues. In qualitative research, scholars (Toyon, 2021; Younas et al., 2023) suggest that the process begins with formulating research questions and continues with developing methods for gathering sources of evidence from participants, followed by data analysis and interpreting what the findings indicate.

Unlike quantitative methods, qualitative methods allow the researcher to take notes during engagement with the interviewee to preserve the conversations for future referencing. One notable advantage of qualitative research is its capacity to safeguard participants' textual material, facilitating a comprehensive comprehension of their social environment. This advantage, however, is often forfeited when using quantitative methodologies (Lincoln, 2005). According to O’Cathain (2010), qualitative research aims to build theories that provide interpretations of a social process that reveal participants’ perspectives and views and not the meaning held by the researcher. Also, the qualitative research method was found suitable to help understand the interviewees' views and opinions in their social context (Lincoln, 2005).

To address the complexities associated with the decision to adopt USSD technology for digital financial services in Nigeria based on the proposed USSD technology adoption framework, subject matter experts were interviewed on variables that could improve USSD technology adoption for digital financial services in Nigeria by administering semi-structured interviews with y managers and industry experts drawn from the banking and telecommunications sectors in Nigeria to extract their perspectives.

4.7.1 Research Instrument

A semi-structured interview questionnaire developed based on the constructs of the USSD technology adoption framework was used to elicit information from industry subject matter experts to evaluate the results of the quantitative data analysis. The semi-structured interview questionnaire enables an in-depth interview that is "open-ended, flexible, and conversational." Questionnare can be used to collect in-depth information and insights from a single person or a group about a specific experience or subject matter. These interviews aim to "understand the participants' perspectives and experiences," and the questions can take various forms. While conducting an in-depth interview, the interviewer will offer the interviewee open-ended questions designed to elicit detailed responses on their views, feelings, and experiences. In comparison to other research techniques, this particular kind of interview makes it possible to go more deeply into a subject and may produce data that is both rich and detailed (Brannen, 2005).

The in-depth interview guide comprises two sections that perform a qualitative analysis of the proposed USSD technology adoption framework (Appendix II). Using the variables of the proposed framework, which are Stimulus (Features and Capability of USSD Technology – Design, Security, Information Quality, and System Quality), Organism (Motivation to use USSD Technology- User experience, Perceived Usefulness, Perceived Risk and Perceived Trust) and Respond (adoption and Usage of USSD technology- Consumer Intention to use USSD technology for digital financial services and User satisfaction), section one focuses on existing obstacles to using USSD technology for digital financial services in Nigeria to validate the results of the quantitative analysis. Section two focused on the benefits of using USSD technology and the internal and external challenges faced by the USSD platforms from the banking industry's perspective.

To complement the quantitative questions, other topics covered in this section include the knowledge and effectiveness of the technical design of the USSD platforms; the security (reliability, safety, and privacy in using USSD technology) to perform digital financial services; the quality of the USSD system; the quality of the information; the user experience; perceived usefulness, risk, and trust of the USSD while performing digital financial transactions; and the perceived trust of the USSD. The second part of the qualitative results analysis chapter proposed potential solutions to the problems affecting the adoption of USSD technology for digital financial services in Nigeria. Opinions of the subject matter experts interviewed were sought to understand regulatory, technology, and tactical-driven approaches to improve USSD technology adoption for digital financial services in Nigeria.

4.7.2 Data Sampling Method and Size

Stratified purposive sampling, a non-probability sampling strategy, was used in the qualitative study to determine interviewees. The stratified sampling method involves identifying subgroups in a population and then purposively selecting participants from each subgroup to enable the researcher to identify characteristics and expertise for the subgroups and compare and contrast across the subgroups (Theodorou, 2013). In qualitative research, the use of stratified purpose sampling places a significant amount of reliance on the capacity of the distribution across different fields and expertise to give valuable and thoughtful insights into the research issue or questions being investigated (Creswell and Plano, 2011). This study identified and approached subject matter experts within the banking and telecommunication services sectors, which have a mix of senior managers, chief information officers, and deputy general managers across industries.

Using these subject matter experts provides a blend of expertise that can provide tactical and strategic insights into USSD technology innovation, operationalisation, commercialisation, productisation, and service improvements. The choice of stratified purposive sampling was also justified, given that USSD technology delivery for digital financial services transcends three service verticals – telecommunication, banking, and payments services. According to Creswell (2007), the sampling size in qualitative research cannot be generalised to fit all situations because it is contingent not only on the study's credibility but also on the researcher's understanding of the populations being studied, the research domain, and other factors. The approach adopted for this study also aligns with the views of Doyle et al. (2009), who opined that sampling size in qualitative research can be determined from the researcher's understanding of the population.

According to Doyle et al. (2009), the quality of analysis is more significant than the number of interviews. This also aligns with the views of other researchers (Ramzan, 2023b; Sivan, 2023; Younas et al., 2023) who suggest that in the qualitative research technique, a few people with more depth and expertise on the phenomenon are required. Based on these opinions, twenty interviewees were identified owing to the selected interviewees' knowledge and expertise spread across different sectors of banking, telecommunication, and national switching company (NIBSS – the company that processes all USSD-based payment transactions within the Nigerian banking industry) to provide the required insights and expertise into the qualitative question on USSD technology adoption to perform digital financial services. Interviewees who are bank officials obtained prior approvals before participation. Also, all the interviewees consented to contribute to the questionnaire voluntarily.

4.7.3 Qualitative Interview

A qualitative interview is a procedure to elicit information, beliefs, or opinions from another person, which involves an interviewer reading questions to respondents and recording their answers (Kumar, 2011). An interview is a verbal interchange between two or more individuals with a specific purpose. The semi-structured interview method was used as the qualitative data collection method. Face-to-face interviews with eight participants from the telecommunication and banking sectors and online through Zoom with four participants who could not meet for a face-to-face discussion. Because of the flexibility of the interviews, the researcher was able to socialise freely but in-depth with the participants, allowing them to talk freely about USSD technology adoption within the Nigerian banking industry. The instrument consists of open-ended questions to engage interviewees during the session (Appendix II).

Interviewers were contacted through electronic email followed by a mobile phone call to schedule at their preferred time out of multiple choices of duration proposed to schedule the interview session. Most interviewees suggested a time after working hours to allow total concentration out of the work schedule. Based on the framework variables to improve USSD technology adoption to perform digital financial services in Nigeria, the interview guide was developed as structured questions (the responses were categorised according to predefined codes) with open-ended questions which gave scope for probing (responses were transcribed and analysed qualitatively). Interviewees were engaged in in-depth conversation. During qualitative interviews, the researcher has the freedom to decide the format and content of questions to be asked of the respondents, select the wording of questions, decide the way questions should be asked, and choose the order in which they are to be asked.

The process of questioning can exhibit varying degrees of flexibility, allowing the interviewer to either generate questions spontaneously based on the subject matter under investigation or adhere strictly to predetermined questions, including their specific wording, order, and manner of delivery

(Kumar, 2011). The research adopted the inflexible type of qualitative interviews to ensure a focused interview session. Before beginning the interview session, the interviewer ensured consent through a signed permission form and understanding of the questions to be asked beforehand from the participant. A voice recorder was used to obtain the recording, which was later transcribed. Before the interview session, participants knew that the voice recorder was turned on and functioning correctly. This is required to ensure the expression of contradictory views and feelings illuminated over broader theoretical concerns and the multi-faceted nature of human consciousness to analyse variables of the phenomenon under study, such as the USSD adoption framework, which can be referenced (Brannen, 2005).

4.7.4 Data Analysis Method

To ensure that all data were accounted for, the interviews were recorded on a digital audio recorder as consented to by interviewees and transcribed verbatim to paper verbatim for purposes of analysing further (example in Appendix IV). In the qualitative analysis phase, data were organised into patterns of categories and themes using an inductive data analysis technique that allows meaningful insights into data patterns (Younas et al., 2023). An inductive research technique was used to develop themes for the transcribed data. In qualitative research, the inductive approach is often used to generate specific meanings or facts from data (Theodorou, 2013). Additionally, this demonstrated the interdependencies of various variables in the study (Creamer, 2017). Before coding and classifying the data into themes, the data were subjected to a thematic analysis. Thematic content analysis is among the most often utilised data analyses in qualitative research approaches.

Based on what was recorded during the interview and the researcher's existing knowledge, the transcribed interview material was divided into major themes by looking for similarities as part of the quantitative data analysis. Using a combination of pre-set commonalities and the researchers' knowledge of the context of the study, data can be coded and classified until themes emerge or are discovered. (Theodorou, 2013). Responses from the semi-structured interview were coded and then organized into themes for analysis to understand data patterns better. This allowed the researcher to manually organise and thoroughly evaluate the data using a Microsoft Excel spreadsheet (Theodorou, 2013). According to Theodorou (2013), content analysis of recorded material enables the systematic identification and thematisation of patterns in many areas of interest.

There are now more computer software tools available to help in QUAL data analysis, and these systems have become better in quality and effectiveness, enabling them to provide advanced techniques for managing and organizing data. Researchers using mixed methods should be aware of the benefits and drawbacks of software tools as well as the appropriateness of each for a particular research endeavour. Researchers must use software that facilitates thorough QUAL data analysis (Theodorou, 2013). These software programs are named computer-assisted qualitative data analysis, or CAQDAS, and they assist in administering and analysing qualitative data. Although coding may be done manually in research, it can be efficiently done using qualitative analysis software that now leverages technological advancement and software that uses machine learning and artificial intelligence (AI) capabilities.

In the study, the NVivo application was used, which allowed data codes to be organised, imported, and analysed. The analysis report is shown in Appendix V. During coding for every transcript in the study, nodes were prepared and grouped based on the study's research questions, a unique attribute of the initial themes using the NVivo software. For instance, any nodes relating to a research question were grouped under a unique group identifier. This was replicated for subsequent questions and folders that were created. To draw inferences based on codes and categories generated, the properties, dimensions, and patterns were explored from the result to present the analysis.

4.7.6 Data Reliability and Validity

As discussed in section 4.6.4, validity testing of the instrument used for data collection ensures it can be used to measure what should be measured. In addition, the validity test aims to find out if there are statements on the questionnaire that must be replaced because they are considered invalid (Sovania & Erasashanti, 2020). Because inaccuracies can enter a study at any point, Kumar (2011) opined that the concept of validity and reliability can be applied to the entire research process or any of its steps, including the design of the research, the sampling method, the results reached, the statistical processes employed, or the measuring procedures utilised (Kumar, 2011). Given this consideration, there has been a need for qualitative researchers to enhance the rigour of their methodology to mitigate any criticism from those who exhibit a predisposition towards quantitative research (Sovania & Erasashanti, 2020).

As proposed by Kumar (2011), the study ensures that the reliability of the qualitative data elicited to investigate the proposed USSD technology adoption framework is established by recording the sessions to promote trustworthiness and credibility. Ensuring the reliability and validity of data is an essential part of research data quality assurance. This is important to ensure that external impact, such as changes in policy, regulation, or technology of use, does not interfere with the findings. To validate the transcribed data, the study adopted a content validation method. Content validity allows the assessment of the items of an instrument, coverage of the issue, and adequate representation (Kumar, 2011). To validate the transcribed data, the researcher produced a copy for each interviewee and sent it by email to each participant to get their feedback. The quality assurance procedure ensured that what was recorded during the interviewing session represented what was transcribed and analysed (sample transcribed data in Appendix VII). This allows the researcher to ensure the integrity of interviewees' responses before the study is entirely written and published.

4.7.7 Integration of Results

Systematically examining discrepancies or similarities between results obtained through multiple research methodologies is crucial to academic research. According to O'Cathian (2010), disagreement is not a sign that something is wrong with a study but the exploration of any apparent "inter-method discrepancy," which may lead to a better understanding of the research question. The researcher integrates the results of qualitative and quantitative methods to examine different aspects of an overall research question. However, in social science, triangulation was used to mean something very different: to ascertain how other methods check, validate, or corroborate one another (Brannen, 2005). As discussed in sections 4.5.1 and 4.5.3, triangulation was used to integrate results. This helps the researcher with separate data collection and analysis procedures for each component to produce two findings (O'Cathain, 2010). Firstly, findings from the quantitative analysis (questionnaire) of the USSD technology adoption framework were reviewed to develop qualitative methods (semi-structured interviews).

Results were correlated and used to assess the impact of constructs of the USSD technology adoption framework on consumers' decision to adopt USSD technology for digital financial services and the satisfaction derived from using the technology for DFS.

4.8. Validating Mixed-Methods Research

There is no clear definition of all aspects of mixed-methods research, including the centrality of mixing or the integration of quantitative and qualitative data sets in a single study (Creamer, 2017). According to Hamilton (2018), mixing is part of the specialised language of mixed methods researchers. It is the linking, merging, or embedding of quantitative and qualitative strands of a mixed-methods study. Scholars (Kadushin et al., 2008; Said, 2023; Sivan, 2023; Vivek, 2022) have debated the relative merits of mixed-methods research, which is not present when the strands of mixed-methods study are kept parallel or distinct. According to Hamilton (2018), mixed-methods research is employed in the social and behavioural sciences, wherein the researcher collects both quantitative (closed-ended) and qualitative (open-ended) data. These two types of data are then integrated, and interpretations are derived from the combined strengths of both data sets. This approach aims to gain a comprehensive understanding of research problems.

While quantitative research guides sample sizes required for specific statistical processes, qualitative research provides (Morgan, 2007). Creswell and Plano (2011) identified a core procedure for validating mixed-method research. The researcher (i) collects and analyses persuasively and rigorously both qualitative and quantitative data (based on research questions) (ii) mixes (or integrates or links) the two forms of data concurrently by combining them (or merging them) by having one build on the other sequentially, or by embedding one within the other (iii) gives priority to one or both forms of data (in terms of what the research emphasizes) (iv) uses these procedures in a single study or multiple phases of a program of study (v) frames these procedures within philosophical worldviews and theoretical lenses (vi) combines the procedures into specific research designs that direct the plan for conducting the study.

As discussed in the previous sections, mixed methods research offers a practical approach to addressing research problems and questions and the potential for increased applicability because these problems and questions are examined in different ways (Maforah & Leburu-Masigo, 2018; Monageng, 2023; Ramzan, 2023b; Vivek, 2022). In the investigation of the proposed USSD technology adoption framework under this study, it is impossible to dispute the benefits of mixed methods research in generating new knowledge and contributions; through triangulation and from a more thorough description of the phenomenon, the use of a mixed methods research strategy had successfully improved the validity of the research outcome (Vivek, 2022). Therefore, the fact that mixed methods research needs extraordinary expertise and resources to be successful is its most significant obstacle. The integration of qualitative and quantitative results has helped to bring out the strength of factors that could improve USSD technology adoption for digital financial services in Nigeria, as discussed in Chapter 7 of this study.

4.9 Ethical Considerations

Ethics in research pertains to a set of principles or anticipated social standards of behaviour that guide the research process. Ethical conduct applies to the organisation and the members that sponsor the investigation, the researchers who undertake the research, and the respondents who provide them with the necessary data (And & Bougie, 2013). Before beginning the quantitative and qualitative data collection procedure, permission to use primary data sources and ethical clearance was obtained. Approval was received from Nigeria Interbank Settlement System Plc (NIBSS) to utilise and analyse processed transaction volume across the banking industry to determine transaction volume spread per bank regarding customer base distribution in Nigeria (Appendix IV). This enabled the selection of top banks contributing over 90% of Nigeria's USSD transactions to ensure a high representation of respondents. This is also in tandem with the ICAD report regarding the distribution of customer base across the banking industry, which NIBSS directly manages.

In addition, ethical clearance was obtained from the University of Western Cape before the data collection process began (Appendix III). For both qualitative and quantitative data collection, consent for voluntary participation was obtained from all participants, who were assured of the anonymity of information shared and the confidentiality of all transcripts (Appendix V). All notes and recorded tapes were safely kept and securely protected in a lockable place, and the names of the participants were disguised.

4.10. Chapter Summary

This chapter provided an overview of the research methodology used to verify the framework for investigating USSD technology adoption for digital financial services in Nigeria. This chapter further elucidated the justification for using mixed techniques to verify the USSD adoption framework and ascertain its appropriateness in addressing the research inquiries. Examining the research philosophy significantly bolstered the foundation of the study and deepened our understanding of other perspectives. Furthermore, the research philosophy discussed in this chapter provided the paradigm that aided in the development of the research and helped position the study by articulating whether or not the study design was appropriate. Furthermore, the chapter provided insights into the research paradigm, which plays a vital role in defining various philosophical beliefs and a justification for the pragmatic approach's suitability, underpinning this study and assessing how relevant they are for the study.

The chapter discussed the ethical clearance procedure, which was duly obtained before proceeding with data collection. Also, participants' consent was assured before data collection began. Also, the challenges with data collection procedures and the commencement period were discussed. The chapter also provides insight into the suitability of explanatory sequential mixed methods and the approach for data collection, validation, and analysis, sequentially. To provide a statistical and contextual basis for the research question, this chapter presented the approach adopted to collect data, validate the data, and analyse responses received using both qualitative and quantitative methods. In addition, a justification for integrating quantitative and qualitative results to enrich the outcome of correlations of the findings was discussed. The results of the study's quantitative data collection and analysis procedures will be presented and discussed in the following chapter.

CHAPTER 5- DIAGRAMMATIC OVERVIEW

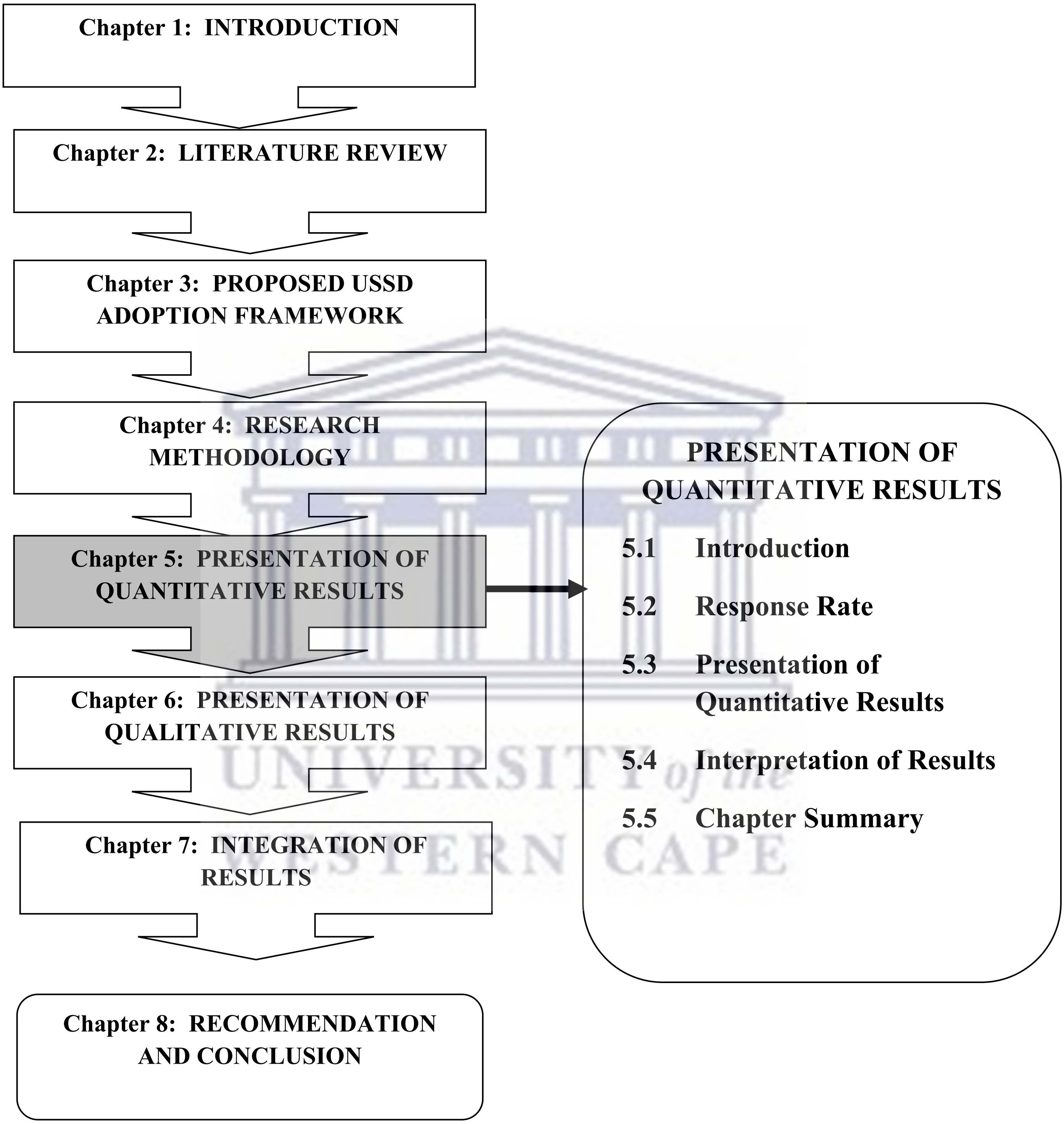


Figure 5.0: Diagrammatic Overview of the Quantitative Results

CHAPTER 5- PRESENTATION OF QUANTITATIVE RESULTS

5.1. Introduction

The study proposed a framework to investigate how to improve the adoption of USSD technology adoption to perform digital financial services in Nigeria based on the constructs of the proposed USSD technology adoption framework, which are Stimulus (Features and Capability of USSD Technology – Design, Security, Information Quality and System Quality), Organism (Motivation to use USSD Technology- User experience, Perceived Usefulness, Perceived Risk and Perceived Trust) and Respond (adoption and Usage of USSD technology- Consumer Intention to use USSD technology for digital financial services and User satisfaction) To accomplish this, it examined the current challenges of Unstructured Supplementary Data Service (USSD) technology adoption for digital financial services in Nigeria and how the current challenges in using USSD technology for digital financial services in Nigeria can be addressed.

It also examined the impact of stimulus factors (features and capabilities of the USSD technology) and organism factors (motivating factors for using USSD technology) on the adoption of USSD technology. In addition, this chapter presents the quantitative research results (survey) utilising a standardized questionnaire. The survey findings were assessed using frequency count, straightforward percentages, the Chi-square test, and multiple linear regression. Some of the most critical findings were also highlighted using graphs. The survey included 511 individuals who responded to the questions, and all analyses were based on their responses.

5.2. Response Rate

The accuracy of response and response rate in academic research is paramount. Response rate refers to the proportion of participants who respond to a survey or other research method out of the total number of participants invited. A higher response rate generates quality interaction effects on the research outcome (Wu, Zhao, & Fils-Aime, 2022). According to scholars (Adela, 2022; Maforah & Leburu-Masigo, 2018; Said, 2023; Sivan, 2023; Toyon, 2021), before doing academic research, it is vital to test the impact of format and design parameters on questionnaire completeness and rate of response to the survey instruments by respondents. Scholars (Deutskens, De Ruyter, & Wetzels, 2004) suggest that response rates are essential in research because low response rates can affect the validity and generalisability of the research findings. Cook et al. (2000) also allude to this assertion after conducting a meta-analysis to systematically examine survey response rates, deducing that response rate could impact research outcomes and can vary widely depending on the research method, the studied population, and other factors (Cook, Heath, & Thompson, 2000). Cook et al. (2000) further suggest that evaluating the response rate of research outcomes is essential to ensure transparency and to allow for a thorough evaluation of the potential impact of non-response bias on the study findings.

Based on the views of Cook et al. (2000), the response rate of respondents for this study was considered a critical component that can impact the validity and generalizability of the findings. Although a minimum sampling size of 400 respondents was targeted for the study, during data collection, the researcher reached out to 600 respondents who fully consented to participate in the quantitative survey to increase the response rate, and this also created a buffer for non-responsive respondents within the already sampled population. According to the calculation, an 85% response rate was recorded (511 out of 600).

5.3. Presentation of Quantitative Results

This section presents the results of the quantitative analysis of the study. Using a survey technique to elicit responses from respondents, as discussed in the previous section, this section also provides empirical evidence of the significance level of all USSD technology adoption framework constructs.

5.3.1 Factor Analysis and Reliability of the Instrument

To determine whether the data is adequate for factor analysis, the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA) was found to be 0.857. This value of KMO is above 0.5, and Bartlett's Test of Sphericity was significant ($p = 0.000$, $p < 0.05$), implying that the correlations were large enough; hence, it was necessary and sufficient to use the factor analysis model. Ten (10) PCAs were extracted, which accounted for a cumulative percentage of 56.723% (Appendix VI)). The factor loadings are presented in Table 5.1. The result shows that the item-total correlation was positive and more than 0.30 on each factor, suggesting that the items were valid and justifying their inclusion on the instrument.

Table 5.1: Summary of the KMO Test and Bartlett's test of Sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.857
Bartlett's Test of Sphericity	Approx. Chi-Square	5618.521
	Df	703
	Sig.	.000

Table 5.2: Summary Result of the Reliability of the Instrument

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.869	.879	36

The instrument's reliability was assessed using the Cronbach Alpha, and the result yielded a reliability coefficient of 0.869, which is greater than 0.70, thus indicating a reliable scale. The summary result of the reliability of the instrument is shown in Table 5.2, and further details are in Table 5.3.

Table 5.3: Reliability of the Instrument –Total statistics

	Scale Mean	**Scale Variance**	**Corrected Item-Total Correlation**	**Cronbach's Alpha Value**
Q1	95.3258	271.385	.356	.867
Q2	95.4569	270.341	.377	.866
Q3	95.6487	265.759	.439	.865
Q4	95.6663	267.659	.357	.866
Q5	96.5098	269.309	.340	.869
Q6	95.4041	268.765	.399	.866
Q7	95.6950	271.156	.498	.866
Q8	96.3278	262.695	.340	.867
Q9	96.0245	265.372	.345	.866
Q10	96.4902	260.894	.402	.865
Q11	96.5763	255.960	.430	.865
Q12	96.1849	268.301	.375	.866
Q13	96.0147	264.541	.364	.866
Q14	96.0793	271.328	.310	.862
Q15	96.3376	264.482	.344	.866
Q16	95.5489	270.171	.320	.867
Q17	96.0029	266.383	.317	.867
Q18	96.0280	266.697	.649	.863
Q19	95.5176	266.939	.420	.865
Q20	96.4295	255.493	.532	.862
Q21	96.7622	260.378	.444	.864
Q22	95.8092	263.700	.454	.864
Q23	95.9168	264.773	.397	.865
Q24	96.8209	266.322	.358	.866
Q25	96.4061	272.556	.345	.866
Q26	96.6252	267.320	.355	.866

Q27	96.6624	262.838	.425	.864
Q28	96.4354	265.287	.302	.867
Q29	96.2397	258.491	.470	.863
Q30	95.8875	263.093	.467	.864
Q31	96.1732	259.617	.473	.863
Q32	95.9501	262.175	.502	.863
Q33	95.9873	262.549	.403	.865
Q34	96.0068	266.016	.333	.866
Q35	96.0890	266.866	.308	.867
Q36	96.1712	262.381	.374	.866

5.3.2 Demographic Characteristics of Respondents

The distribution of the respondents by gender reveals that a slightly higher percentage of the respondents was males (50.1% versus 49.9%). The distribution of the respondents by age indicates that more than half of the respondents were between 18-35 years (57.7%), and only a very few were 51 years and above (7.4%). In terms of their occupation, the majority of the respondents were workers (45.8%), followed by business owners (41.9%), while a few of them were unemployed (3.3%). The distribution of the respondents by education shows that more than half of the respondents had tertiary education (68.5%), with very few having no formal education (1.4%). Figure 5.1 – 5.4 presents the demographic analysis of respondents.

Distribution of respondents by gender -The results in Figure 5.1 show that slightly more males (50.1%) than females (49.9%) have adopted the USSD to access digital financial services in Nigeria. This also corroborates the financial inclusion access report released by EFInA (EFInA, 2021). The report examined the Nigerian adult population for male and female ratio of access to digital financial services. The study results indicate that males have the most accessibility to digital financial services in Nigeria.

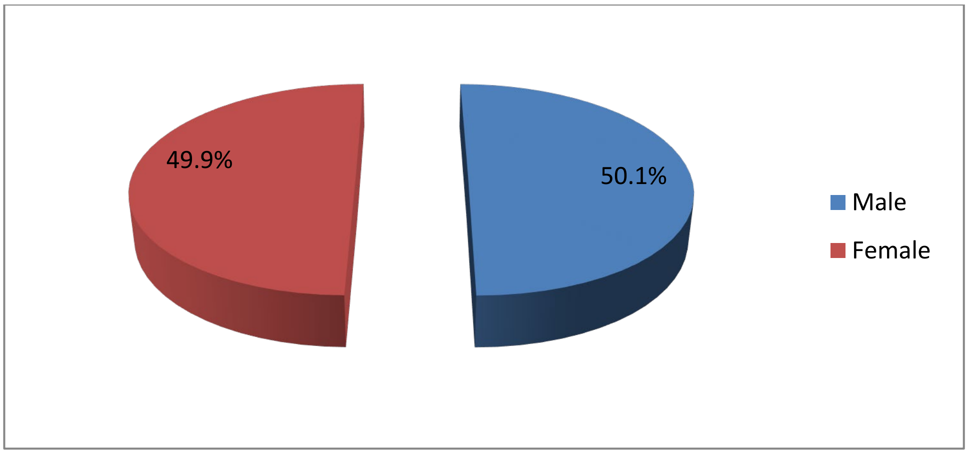


Figure 5.1: Distribution of respondents by gender

Distribution of respondents by age –As shown in in Figure 5.2, results indicate that most of those who use USSD to access digital financial services are within the 18-35 age bracket. This also aligns with the EFInA report which indicates that about 55% of the sampled population in the digital financial access survey are 35 years and younger (EFInA, 2021).

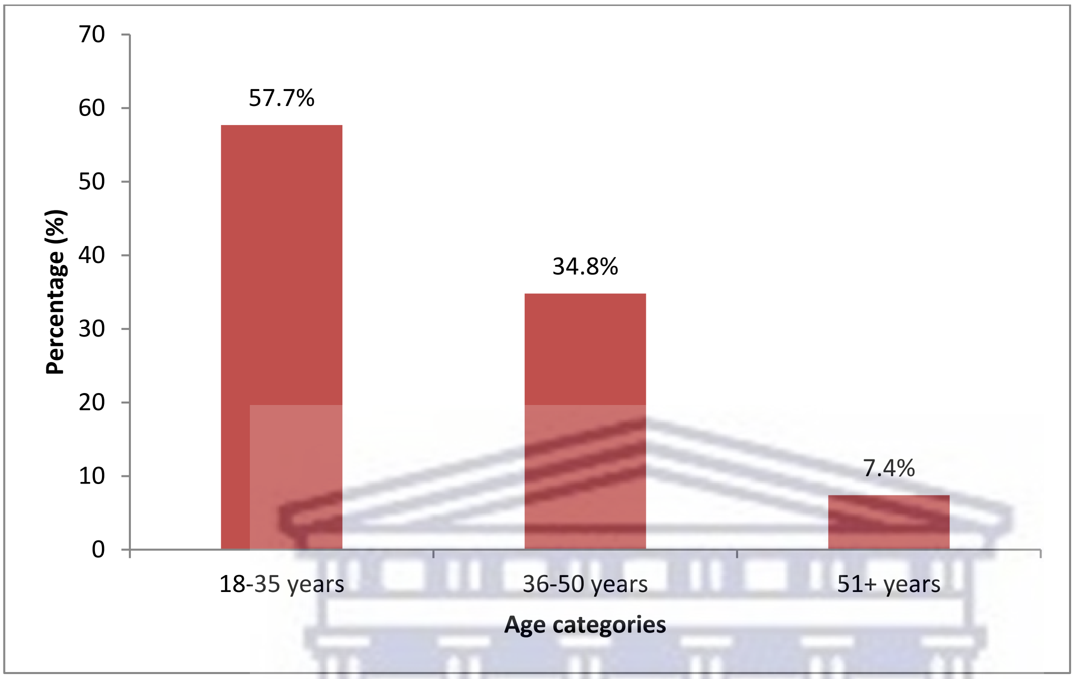


Figure 5.2: Distribution of the respondents by age (years).

Distribution of respondents by occupation / profession –As shown in Figure 5.3, 87.7% of respondents using USSD technology for digital financial services are employed or have a business set-up. This implies they may be performing payment transactions based on their incomes. The Figure also shows that 9% of USSD technology users are students. The result also aligns with the report presented by EFInA that 19% of the respondents sampled for DFS access have no formal education (EFInA, 2021).

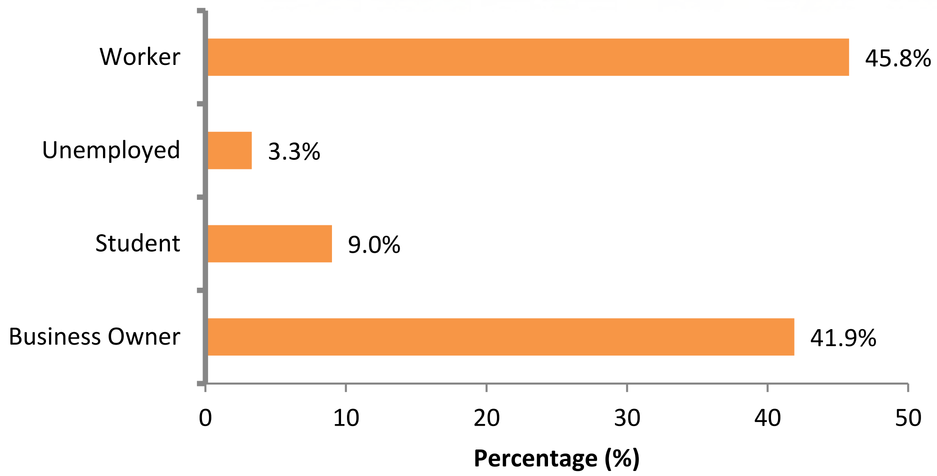


Figure 5.3: Distribution of respondents by occupation or profession

Distribution of respondents by education level –As shown in Figure 5.4, 1.4% of respondents are without formal education despite their ability to perform USSD-based digital financial services. This is also shown evident in the EFInA report which indicates that the population in Nigeria with access to bank accounts increased from 38% in 2016 to about 50% in 2021 (EFInA, 2021). This implies education is not a barrier to accessing USSD technology for digital financial services (David-West, 2020; Idriss & Ajiya, 2022; Wezel & Ree, 2023).

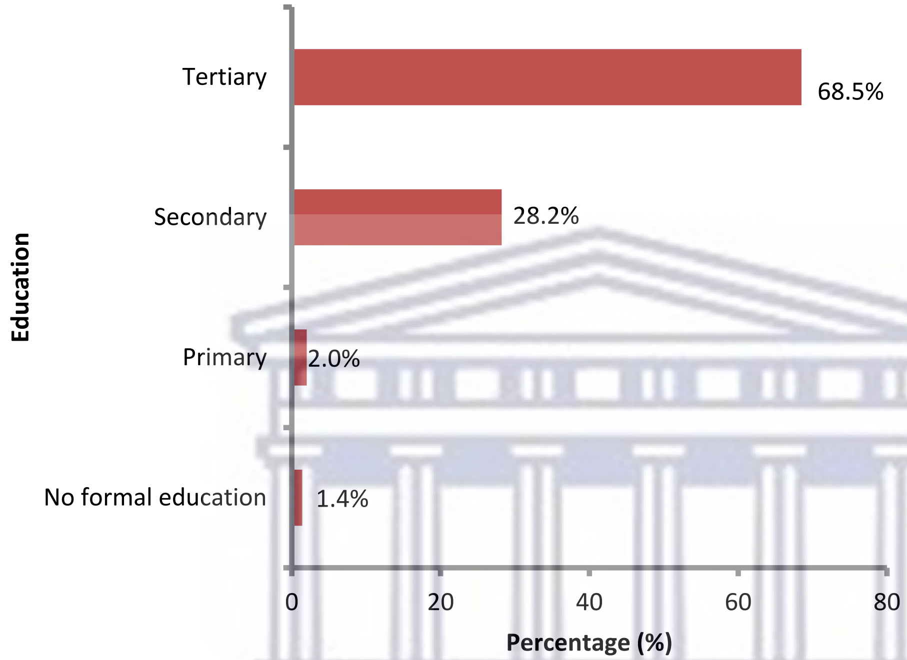


Figure 5.4: Distribution of respondents by education

5.3.3 Presentation of Results with the Framework Constructs

As discussed in Chapter 4, the quantitative data analysis for the proposed USSD adoption framework is based on the following constructs: Stimulus (Features and Capability of USSD Technology – Design, Security, Information Quality, and System Quality), Organism (Motivation to use USSD Technology- User experience, Perceived Usefulness, Perceived Risk and Perceived Trust) and Respond (adoption and Usage of USSD technology- Consumer Intention to use USSD technology for digital financial services and User satisfaction).

5.3.3.1 Stimulus (Features and Capability of USSD Technology)

Technology adoption resistance is primarily driven by the challenges adopters face of these new technologies (Dougherty, 2017; Hidayat-Ur-Rehman et al., 2021). To identify the current challenges of Unstructured Supplementary Data Service (USSD) technology adoption for digital financial services in Nigeria, the respondent's ratings of the major features of the USSD technology were assessed. These rated features include the technicality, quality, security, information quality, perceived risk, and trust of the USSD technology. The summary results of each USSD technology feature and associated challenges are presented in Figures 5.5 to 5.8.

5.3.3.1.1 Rating of USSD Technology Design on Consumer's Motivation to Use USSD Technology for Digital Financial Services

Respondents' ratings of the technicality of the design of the USSD technology are presented in Figure 5.5. This was done to determine whether there is any challenge with the technicality of the design of the USSD technology. From a sample size of 511 respondents,

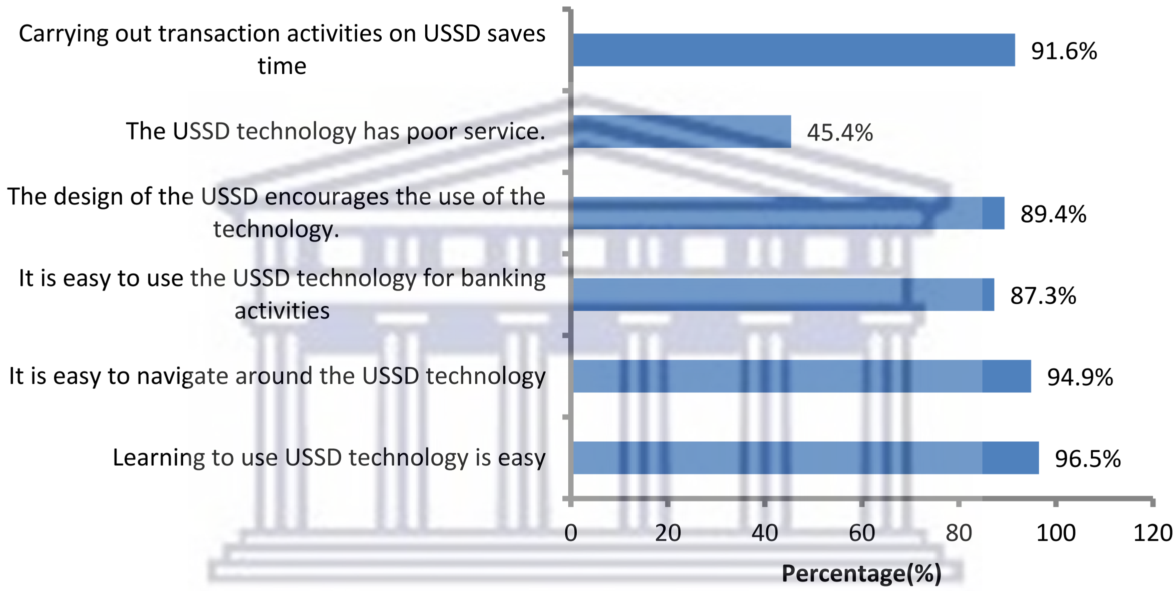


Figure 5.5: Rating of the design of the USSD technology

The result as presented reveals that more than half of the respondents indicated that learning to use USSD technology is effortless (96.5%), easy to navigate around (94.9%), easy to use for banking activities (87.3%) and that the design of the USSD encourages the use of the technology (89.4%). The result also reveals that most respondents opined that carrying out transaction activities on USSD saves time (91.6%). In comparison, less than half of the respondents complained of the poor service of the USSD technology (45.4%). Hence, there is no identified technical challenge associated with using USSD technology for transactions except for the poor technology services, which was observed by less than half of the respondents. From the results, it is evident that the USSD platforms in Nigeria are user-friendly. This is especially true since the respondents consider learning, navigating, and using the USSD platform for banking services to be easy, the USSD design encourages the use of technology, the USSD has a good service, and carrying out transactions on USSD saves time.

It can be deduced that the most rated design of the USSD technology is that it is easy to learn (96.5%) followed by the ease of navigating around the Technology (94.9%) while less than half of the respondents rated the service as very poor (45.4%).

5.3.3.1.2 Rating of the Security of the USSD Technology on Consumer's Motivation to Use USSD Technology for Digital Financial Services

The study also evaluated respondent's concerns around the security of the USSD technology to discover if there are security and quality challenges with the USSD technology. As shown in Figure 5.6, more than half of the respondents indicated that it is safe from internet fraud when using USSD technology (60.7%), the authentication process on the USSD technology is enough (76.7%), USSD technology is prone to fraud (53.2%), several people have been fraud victims by using USSD technology (55.8%).

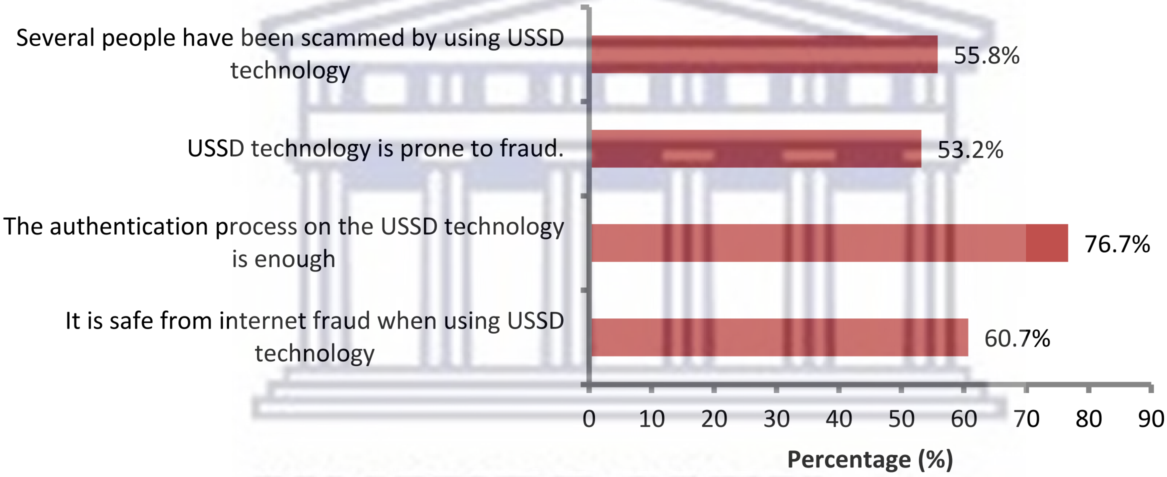


Figure 5.6: Rating of the security of the USSD technology

Based on the analysis result shown in Figure 5.6, it can be deduced that the current security challenge facing the use of USSD technology is that several people have been scammed by using USSD technology. This indicates that security challenges are associated with using USSD technology. From the results, customers are concerned that the USSD technology used to access banking services is prone to fraud and that they know several people who have been scammed on USSD platforms. More than half of the respondents indicated that USSD technology is prone to fraud (53.2%) and that several people have been scammed by using USSD technology (55.8%).

5.3.3.1.3 Rating of Information Quality of the USSD Technology on Consumer's Motivation to Use USSD Technology for Digital Financial Services

The rating of the quality of users' experience of the USSD technology is presented in Figure 5.7. The result, as illustrated reveals that there was no challenge with the accuracy of the information on the USSD (93.5%), the features of the USSD technology cater to all financial needs (56.6%), and whether the USSD lacks enough procedures, less than 50% of the respondents supported the statement (37.2%) meaning that in the real sense, the USSD does not lack enough procedures.

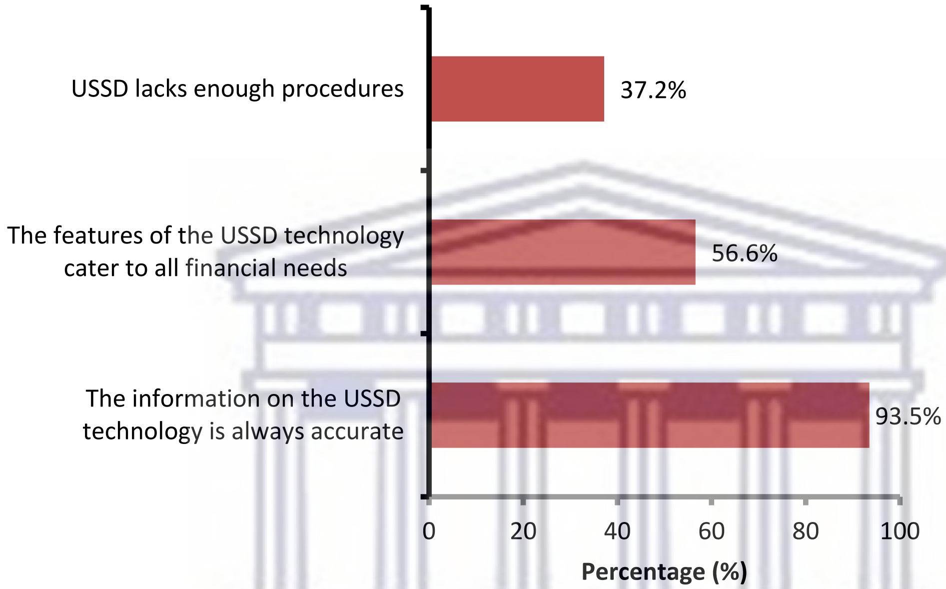


Figure 5.7: Rating of information quality of the USSD technology

From the results as shown in Figure 5.7, it is evident that USSD customers have no issues with the quality of information on USSD platforms. The customers indicate that the information is always accurate, that USSD caters to all their needs, and that USSD has a straightforward procedure. However, customers are not delighted with poor customer service from banks regarding USSD platforms and high bank charges. Some customers also indicate that the system is complicated and lacks the necessary skills to use USSD for digital financial services.

5.3.3.1.4 Rating of System Quality of the USSD Technology on Consumer's Motivation to Use USSD Technology for Digital Financial Services

As shown in Figure 5.8, more than half of the respondents indicated that the USSD technology breaks down frequently (62.4%) and that the system has failed multiple times (62.8%). Therefore, quality challenges confront the use of the USSD technology, ranging from the system failing numerous times to the technology breaking down frequently. On the quality, USSD customers indicate that the technology breaks down very frequently- thus, it has failed them multiple times- and that the use of USSD to successfully transact depends on one's location. The result further indicates that the ease of activation of the USSD technology was the most rated compared with other items (92.4%).

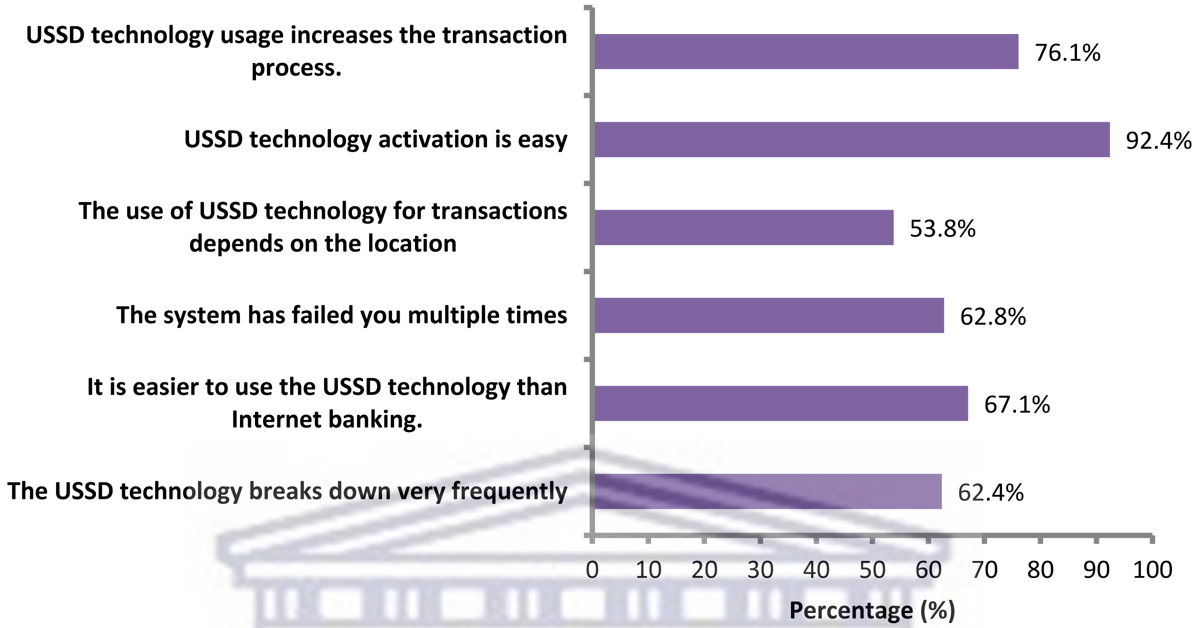


Figure 5.8: Use of USSD Technology

5.3.3.2 Organism (Motivation to use USSD Technology)

5.3.3.2.1 Rating of User's Experience on Consumer's Intention to Adopt and Use USSD Technology for Digital Financial Services

The rating of the users' experience of the USSD technology is presented in Table 5.4. The results reveal that the users were satisfied with using the USSD technology. 52.8% of the respondents complained of a lack of support for customer care services in using USSD technology, with few of them complaining that the system is complicated (23.7%), high bank charges, which discourages its usage (47.2%), bad experiences while using the USSD technology (44.0%) and lack of the necessary skills required to use the USSD technology (30.9%). From this result, it can be deduced that the significant challenges of USSD technology are due to a lack of support and customer service.

Table 5.4: Rating of user experience of using USSD technology

			Affirmative (Strongly agree + Agree)	
	User Experience of Using USSD Technology	n	No. of Respondents	Percentage (%)

1	There is a lack of fulfilment when using the USSD technology	511	193	37.8
2	The quality of the USSD technology is very satisfactory	511	413	80.6
3	The USSD technology is a complicated system	511	121	23.7
4	The usage of the USSD technology has been engulfed by bad experiences.	511	225	44.0
5	There is a lack of the necessary skills required to use the USSD technology	511	158	30.9
6	There is a lack of support for customer care services in USSD technology	511	270	52.8
7	Usage of USSD technology leads to an effective and efficient financial transaction experience	511	419	82.0

Source: Field survey (2021)

From the results in Table 5.4, it is evident that USSD customers are not having a satisfactory experience due to poor customer service from banks regarding USSD platforms and high bank charges. Some customers also indicate that the system is complicated and lacks the necessary skills to use USSD for digital financial services.

5.3.3.2.2 Rating of Perceived Usefulness for on Consumer's Intention to Adopt and Use USSD Technology for Digital Financial Services

The rating of the perceived usefulness of the USSD technology is presented in Table 5.5. Regarding perceived usefulness, the result reveals that the customers embrace the ubiquity of USSD technology to access other financial services (70.8%), and 66.1% agree that USSD technology is cost-effective compared to accessing DFS within bank branches and online. However, less than half of respondents (47.2%) are concerned about the bank charges for using USSD technology, which informs a critical lens of the study as discussed in chapters 1 and 2 of this study.

Table 5.5: Rating of Perceived Usefulness of Using USSD Technology

			Affirmative (Strongly agree + Agree)	
	Perceived Usefulness of Using USSD Technology	n	No. of Respondents	Percentage (%)

1	The use of USSD technology increases the quality of banking transactions	511	417	81.6
2	The bank charges for using the USSD technology discourage its usage	511	241	47.2
3	USSD technology provides access to other financial services.	511	362	70.8
4	The USSD technology gives me greater control over my finances.	511	337	65.9
5	Using USSD technology enables me to carry out more financial transactions	511	386	75.5
6	The USSD is more cost-effective compared to the other means of carrying out banking activities (going to the hall or online banking)	511	338	66.1

Source: Field survey (2021)

From the results in Table 5.5, it can be deduced that USSD technology is an important utility for bank customers to access digital financial services in Nigeria.

5.3.3.2.2 Rating of the Perceived Risk on Consumer's Intention to Adopt and Use USSD Technology for Digital Financial Services

Results in Table 5.6 present the rating of the perceived risk and trust of the USSD technology. The result shows that more than half of the respondents indicated that the USSD technology is open to fraud (53.2%), and only very few complained that using a 4-digit PIN in plain text discourages using USSD for banking (35.0%). Therefore, the major perceived risk of the USSD technology, which is a challenge to the respondents, is that the technology is prone to fraud.

Table 5.6: Perceived Risk of the USSD Technology

			Affirmative (Strongly agree + Agree)	
S/N	**Perceived risk**	n	No. of Respondents	Percentage (%)
1	The USSD technology is open to fraud	511	272	53.2
2	The use of a 4-digit PIN in plain text discourages the use of USSD for banking.	511	179	35.0

Source: Field survey (2021)

Based on the results, it is evident that customers are concerned that the USSD platforms are prone to fraud and indicate that their trust in their banks influences their use of USSD for banking.

5.3.3.2.3 Rating of the Perceived Trust on Consumer's Intention to Adopt and Use USSD Technology for Digital Financial Services

In terms of the perceived trust in the technology, there were no challenges, as more than half of the respondents indicated that the USSD technology had built confidence in its usage (76.3%), improved customer loyalty for banking services (72.6%), and with more than half of the respondents indicating that their trust for their bank affects their use of USSD technology (72.4%).

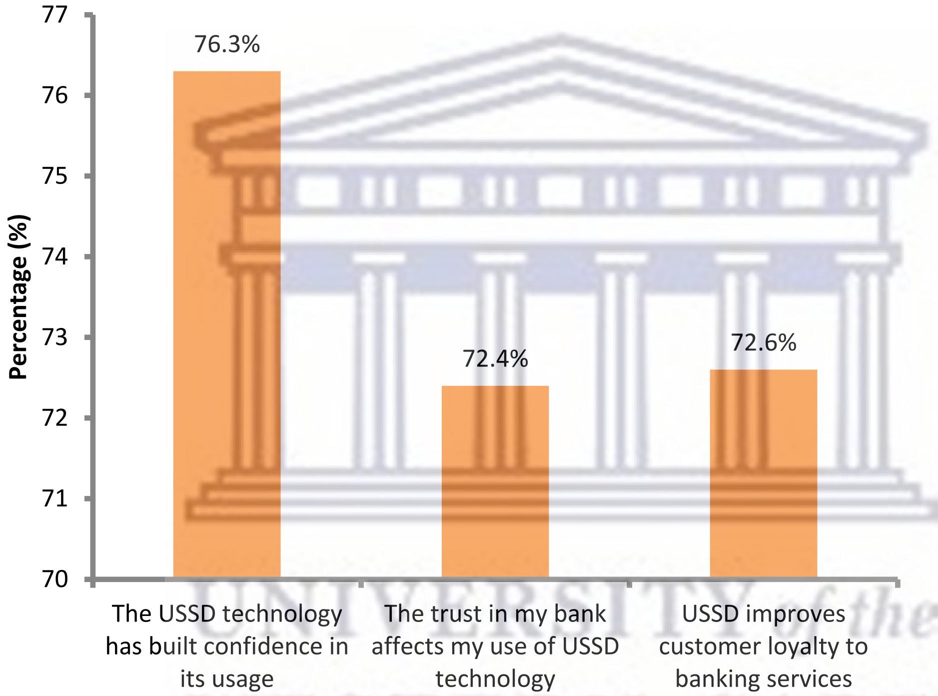


Figure 5.9: Rating of the perceived trust of the USSD technology

Also, from the results shown in Figure 5.9, customers are concerned that the USSD platforms are prone to fraud and indicate that their trust in their banks influences their use of USSD for banking.

5.3.3.3 Response (adoption and Usage of USSD technology)

5.3.3.3.1 Consumer Intention to use USSD technology on the Satisfaction Derived from Using USSD Technology for Digital Financial Services

The results in Table 5.7 depict the use of a 4-digit PIN in plain text does not discourage the use of USSD for banking (35.0%) and that USSD technology has built confidence in its usage (76.3%), affected their trust in their banks (72.4%) and improves their loyalty for banking services (72.6%).

This result shows that, generally, most of the respondents demonstrated an intention to use USSD technology for digital financial services.

Table 5.7: Consumer Intention to use USSD technology for digital financial services

S/N			**Affirmative (Strongly agree + Agree)**	
	Consumer Intention to use USSD technology for digital financial services	n	No. of Respondents	Percentage (%)
1	The use of a 4-digit PIN in plain text discourages the use of USSD for banking.	511	179	35.0
2	The USSD technology has built confidence in its usage	511	390	76.3
3	The trust in my bank affects my use of USSD technology	511	370	72.4
4	USSD improves customer loyalty to banking services	511	371	72.6

Source: Field survey (2021)

5.3.3.4 Response (adoption and Usage of USSD technology)

5.3.3.4.1 Derived User Satisfaction in the Continuous Use of USSD Technology for Digital Financial Services

Table 5.8 presents a summary of the satisfaction with USSD technology. Results reveal that the quality of the USSD technology is very satisfactory (80.6%), it increases the quality of banking transactions (71.2%), provides access to other financial services (69.1%), leads to effective and efficient financial transactions (70.8%), give them greater control over my finances (65.0%), enable them carry out more financial transactions (75.5%) and it is more cost-effective compared to the other means of carrying out banking activities (66.1%).

Table 5.8: Satisfaction with USSD Technology

S/N			Affirmative (Strongly agree + Agree)	
	Users satisfaction	n	No. of Respondents	Percentage (%)
1	There is a lack of fulfillment when using the USSD technology	511	126	24.7
2	The quality of the USSD technology is very satisfactory	511	412	80.6
3	The use of USSD technology increases the quality of banking transactions	511	364	71.2
4	USSD technology provides access to other financial services.	511	362	70.8
5	Usage of USSD technology leads to effective and efficient financial transactions	511	419	82.0
6	The USSD technology gives me greater control over my finances.	511	337	65.9
7	Using USSD technology enables me to carry out more financial transactions	511	386	75.5
8	The USSD is more cost-effective compared to the other means of carrying out banking activities (going to the hall or online banking)	511	338	66.1

Source: Field survey (2021)

5.3.3.4.2 Specific Challenges Confronting the Use of USSD Technology

The respondents were asked to identify their specific challenges with USSD technology, and the result is presented in Figure 5.10. The primary specific challenge was high charges on the application (42.9%) followed by mobile network connectivity issues and then prone to fraud. This result also substantiates some of the challenges identified in rating the different aspects of the USSD technology.

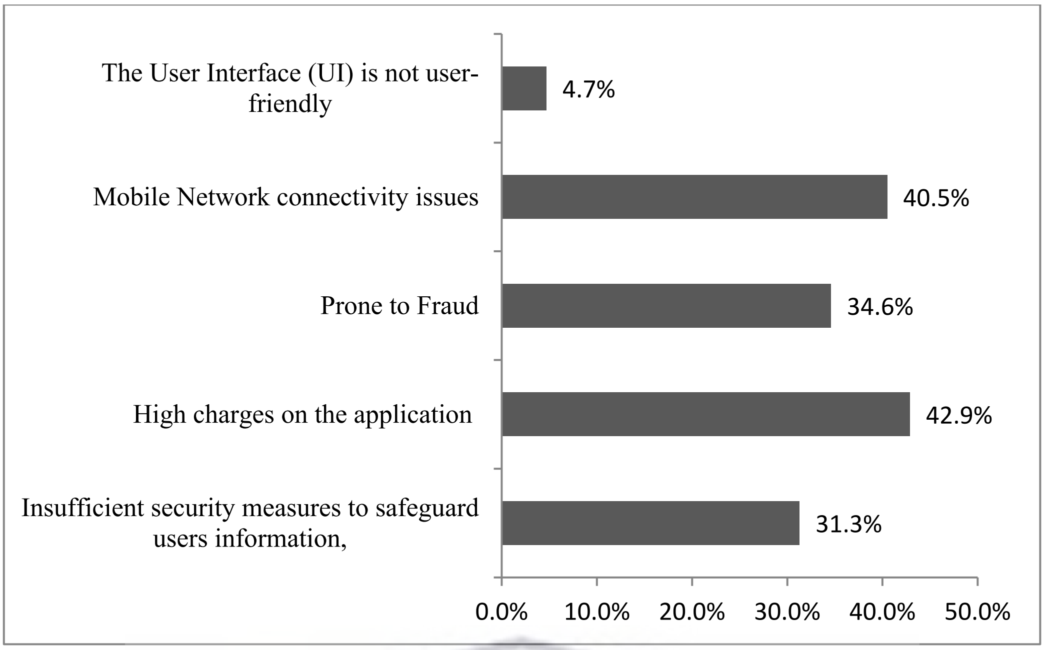


Figure 5.10: Specific challenges facing users of USSD Technology

Figure 5.10 shows that high charges on the applications and mobile network connectivity issues were the two major challenges facing USSD technology users.

5.4 Remediation Analysis from Quantitative Results

During the elicitation of data in the qualitative analysis phase, respondents were also asked about their views on how various challenges can be mitigated to improve adoption. This approach ensures that recommendations made to relevant stakeholders as an outcome of this research are proven and aligned with the expectations of consumers who are at the receiving end.

5.4.1 Analysing How Specific Challenges Can Be Addressed in Relation to Gender

The result in Table 5.15 reveals that more than half of the respondents who complained of insufficient security measures (50.6%), high charges on the application (53.0%), and Mobile Network connectivity issues (52.2%) were female. In contrast, more females than males complained that the technology is prone to fraud (55.9%) and unfriendly users' interface (62.5%). The results also show that most respondents who complained of insufficient security measures, high charges on the application, being prone to fraud, mobile network connectivity issues, and unfriendly user interfaces were 18-35 years old. For occupation, most respondents indicated insufficient security measures, high charges on the application, prone to fraud, and mobile network connectivity issues were business owners, while the majority who complained of unfriendly user interface were business owners. For education, most of the respondents who indicated all the specific challenges identified were those with tertiary education (Table 5.15).

Table 5.9: Analysing How USSD Technology Adoption Challenges Can Be Addressed

	Specific challenges of the USSD technology				
Demographic characteristics	**Insufficient Security Measures**	**High Charges On The Application**	**Prone To Fraud**	**Mobile Network Connectivity Issues**	**Unfriendly User Interface**
Gender					
Male	79(49.4%)	103(47.0%)	99(55.9%)	99(47.8%)	15(62.5%)
Female	81(50.6%)	116(53.0%)	78(44.1%)	108(52.2%)	9(37.5%)
Age (years)					
18-35 years	97(60.6%)	126(57.5%)	103(58.2%)	125(60.4%)	14(58.3%)
36-50 years	50(31.2%)	72(32.9%)	63(35.6%)	71(34.3%)	7(29.2%)
51+ years	13(8.1%)	21(9.6%)	11(6.2%)	11(5.3%)	3(12.5%)
Occupation					
Business Owner	68(42.5%)	90(41.1%)	72(40.7%)	92(44.4%)	13(54.2%)
Student	16(10.0%)	20(9.1%)	19(10.7%)	16(7.7%)	0(0.0%)
Unemployed	6(3.8%)	7(3.2%)	5(2.8%)	10(4.8%)	0(0.0%)
Worker	70(43.8%)	102(46.6%)	81(45.8%)	89(43.0%)	11(45.8%)
Education					
No formal education	3(1.9%)	3(1.4%)	3(1.7%)	2(1.0%)	0(0.0%)
Primary	3(1.9%)	6(2.7%)	4(2.3%)	2(1.0%)	1(4.2%)
Secondary	46(28.8%)	62(28.3%)	46(26.0%)	59(28.5%)	5(20.8%)

Tertiary	108(68.9%)	148(67.6%)	124(70.1%)	144(69.6%)	18(75.0%)

Regarding specific challenges faced by different demographic subgroups, statistics in Table 5.6 report that insufficient security measures, high charges on the USSD platforms, and susceptibility to fraud are challenges experienced primarily by female workers who have attained tertiary-level education and are aged between 18-35 years. On the other hand, mobile network connectivity issues and unfriendly user interfaces are mostly considered hindrances to accessing and using USSD platforms by female business owners with tertiary education and aged between 18-35 years.

Also, Table 5.10 provides an analysis of how the challenges confronting USSD Technology adoption can be addressed. The result shows that 37.8% of the respondents indicated a need to ensure broadly good network connectivity. In contrast, other respondents indicated that improving the up-time of the USSD service (35.0%) and improving the platform's user interface (29.9%) would help address the challenges of the USSD technology. Results also show that more than half of the respondents opined that introducing good security measures/authentication processes (51.5%) and reducing the bank charges per transaction (59.5%) would help address the challenges of the USSD technology.

Table 5.10: Responses on how the challenges of the USSD can be addressed

Responses	No. of Respondents	Percentage (%)	Rank
Ensure broadly good quality of network connectivity	193	37.8	4
Improve the up-time of the USSD service	179	35.0	5
Improve the user interface of the platform	153	29.9	3
Introduce suitable security measures/ authentication processes	263	51.5	2
Reduce the bank charges per transaction	304	59.5	1

From the results in Table 5.10, it is evident that reducing the bank charges per transaction and introducing suitable security measures/authentication processes would be critical in addressing the challenges around the adoption of USSD technology for digital financial services in Nigeria.

5.4.2 Analysing How Specific Challenges Can Be Addressed about Demography

The result summarized in Table 5.11 shows the association between the demographics of these respondents and how the current challenges of the USSD technology can be addressed. The results reveal that more females than males indicate that the everyday challenges of the USSD technology can be addressed by ensuring broadly good quality of network connectivity, improving the up-time of the USSD service, and reducing the bank charges per transaction while more males than females went for enhancing the user interface of the platform and introducing good security measures/ authentication processes.

Table 5.11: Relativity Analysis between the demographic characteristics and the possible ways the challenges of USSD Technology can be addressed

	Possible ways the challenges of USSD Technology can be addressed				
Demographic characteristics	Ensure broadly good quality of network connectivity	Improve the up-time of the USSD service	Improve the user interface of the platform	Introduce suitable security measures/ authentication processes	Reduce the bank charges per transaction
Gender					
Male	93 (48.2%)	85(47.5%)	81 (52.9%)	138 (52.8%)	150(49.3%)
Female	100(51.8%)	94(52.5%)	72 (47.1%)	125 (47.2%)	154(50.7%)
Age (years)					
18-35 years	105(54.4%)	110(61.5%)	88 (57.5%)	153 (58.2%)	179(58.9%)
36-50 years	72 (37.3%)	57(31.8%)	52 (34.0%)	92 (35.0%)	100(32.9%)
51+ years	16 (8.3%)	12(6.7%)	13(8.5%)	18 (6.8%)	25 (8.2%)
Occupation					
Business Owner	89 (46.1%)	74 (41.3%)	66 (43.1%)	103 (39.2%)	124(40.8%)
Student	15 (7.8%)	16 (8.9%)	11 (7.2%)	27 (10.3%)	27 (8.9%)
Unemployed	11 (5.7%)	6 (3.4%)	6 (3.9%)	9 (3.4%)	9 (3.0%)
Worker	78 (40.4%)	83(46.4%)	70 (45.8%)	124 (47.1%)	144(47.4%)
Education					
No formal education	4 (2.1%)	2 (1.1%)	3 (2.0%)	5 (1.9%)	4 (1.3%)
Primary	2 (1.0%)	3 (1.7%)	2 (1.3%)	5 (1.9%)	6 (2.0%)

Secondary	49 (25.4%)	52 (29.1%)	37(24.2%)	73 (27.8%)	88 (28.9%)
Tertiary	138(71.5%)	122(68.2%)	111(72.5%)	180 (68.4%)	206(67.8%)

In summary, female business owners with tertiary education aged 18-35 believe that ensuring good network connections is one way to address the challenges of adopting USSD technology. In addition, female workers with tertiary education and aged 18-35 years believe that improving the up-time of the USSD platforms and reducing the bank charges per transaction would increase the adoption of USSD technology. On the other hand, male workers with tertiary education and aged between 18-35 years believe that improving the user interface and introducing good security measures/ authentication processes would go a long way in tackling the challenges facing the adoption of USSD technology for digital financial services in Nigeria.

5.4.3 Regression Analysis and Testing of Significance Level

A test result is statistically significant when it is deemed as unlikely to have only due to random sampling variability, as determined by a predetermined threshold probability referred to as the significance level (Igwenagu, 2017). In this study, all the hypotheses indicated in Chapter 3 were tested to determine their significance level. Testing the significance level enables the survey to reveal important factors impacting the investigation outcomes based on a pre-specified significance level. For the purpose of this study, a null hypothesis (p-value) value of less than 5% was used (we have essentially set the level of significance at $p < 0.05$).

The result in Table 5.12 summarises the multiple regression of stimulus factors and organism factors: Three different regression models for testing the impact of stimulus and organism factors on the adoption and use of USSD technology for digital financial services in Nigeria. Items on each variable were scored, and the scores obtained on each were used in running the regression. Adoption and use of USSD technology were measured using six items (Q9, Q10, Q11, Q12, Q13, and Q14) rated as follows: 4 for daily, 3 – for weekly, 2- for monthly, 1- for yearly, and 0 for never. For stimulus, 11 items were used (Q19, Q21, Q23, Q24, Q35, Q37, Q41, Q42, and Q52), all rated as follows: 4 – for strongly agree, 3- agree, 2 –disagree, 1- strongly disagree and 0 for undecided while organism was measured with 18 items as indicated on the questionnaire and all rated the same way as the stimulus. All negative things were ranked in the reverse order of 1 – for strongly agree, 2- agree, 3 –disagree, 4- strongly disagree, and 0 for undecided. Model 1 examines the impact of stimulus on the adoption and use of USSD technology controlling for demographic characteristics; model 2 examines the impact of organism on the adoption and use of USSD technology controlling for demographic characteristics. Model 3, on the other hand, discussed the joint impact of stimulus and organism factors on the adoption and use of USSD technology controlling for demographic characteristics. For each regression model, the variance inflation factor (VIF) values were less than 2.0, which is far less than 5.0, implying no evidence of multicollinearity.

Table 5.12: Summary of the multiple regression showing the stimulus factors and organism factors on the adoption and use of USSD technology for digital financial services

Variables	Model 1	Model 2	Model 3
Age	.029	-.052	.009
Sex	-.301	-.338	-.299
Occupation	.253**	.295	.010
Education	-.069	.031	-.059
Stimulus	.297**	-	.238**
Organism	-	.142**	.048**
F-value	51.917	33.921	45.744
R^2	.340	.251	.353
P-value	.000**	.000**	.000**

***Significant at 5% (p<0.05)**

The model significance test results for all the models were significant ($p<0.05$), implying that the regression models captured the relationship between the dependent variable in the case of the adoption of the USSD technology and the independent variables (stimulus factors and organism factors). The adjusted R^2 of 0.340, 0.251, and 0.353 were obtained for models 1, 2, and 3, respectively, which indicates that controlling for demographic characteristics, stimulus factors accounted for 34.0% of the variation in the use and adoption of USSD technology, organism factors accounted for 25.1%. In comparison, joint stimulus and organism factors accounted for 35.3% of the variation in the use and adoption of USSD technology. The result also showed that in both models, stimulus factors significantly positively impact the use and adoption of USSD technology ($\beta = .297$, $p<0.01$ for model 1 and $\beta= .238$, $p<0.01$ for model 3). This implies that after bringing the impact of the organism factor, stimulus factors still maintain a significant positive contribution to the adoption and use of USSD technology for digital financial services.

A similar result was obtained for organism factors as this factor was found to have a significant positive contribution to the adoption and use of USSD technology for digital financial services ($\beta = .142$, $p<0.01$ for model 2 and $\beta= .048$, $p<0.01$ for model 3). However, the contribution was reduced after factoring in the contribution of stimulus factors, as shown in Table 5.12. The joint contribution of stimulus and organism factors was significant (F-cal. = 45.744, p-value =0.000, p<0.01, Model 3), implying that the null hypothesis is rejected. Therefore, there is a significant impact of the stimulus factors (features and capabilities of the USSD technology) and organism factors (motivating factors for using USSD technology) on the adoption and use of USSD technology for digital financial results also reveal that stimulus factors have a more significantly positive contribution to the use and adoption of the USSD technology than organism factors (Model 3). Further analysis was carried out to determine which stimulus factor significantly influences the use and adoption of the USSD technology, and the result obtained is presented in Table 5.13.

Table 5.13: Impact of stimulus factors on the use and adoption of USSD technology after controlling for demographics

Model	Variables	Coefficient (std. error)	R^2	t-stat.	P-value
1	Ease of learning to use	.866(.193)	.069	4.48	0.005**
2	It is easy to navigate around the USSD technology	.823(.182)	.070	4.53	0.005**
3	The design of the USSD	.679(.136)	.078	5.07	0.005**
4	The USSD technology network services	.380(.112)	.053	3.39	0.005**
5	The authentication process of the USSD technology	1.511(.091)	.375	16.65	0.004**
6	Accuracy of the information on the USSD technology	.790(.145)	.086	5.45	0.005**
7	Ability to cater to all financial needs	.602(.095)	.104	6.35	0.005**
8	Adequacy of the USSD procedures	.548(.102)	.084	5.39	0.005**
9	The ease of the USSD technology system	.554(.122)	.070	4.54	0.005**
10	Bank charge	-1.032(.100)	.199	-10.28	0.005**
11	The use of a 4-digit PIN	.520(.108)	.074	4.82	0.005**

Demographic factors were controlled for in each regression, **Significant at 5% (p<0.05).

Table 5.13 shows that all 11 stimulus factors were significant predictors of the use and adoption of USSD technology. Among the factors, Q27 reported the highest coefficient of determination value, meaning that the factors explained more percentage of the variation in the use and adoption of USSD technology than other stimulus factors in the regression models. This factor (Q27) also reported the highest regression coefficient (1.511) and the highest t-calculated value (16.65), which indicates that Q27 has more impact on the use and adoption of the USSD technology than other stimulus factors. Similarly, analysis was also carried out to determine the organism factors that significantly influence the use and adoption of the USSD technology, and the result obtained is presented in Table 5.14.

Table 5.14: Impact of organism factors on adoption and use after controlling for demographics

Model	Variables	Coefficient (std. error)	R^2	t-stat.	P-value
1	Q25	.751(.162)	.071	4.63	0.004**
2	Q26	1.336(.075)	.408	17.92	0.004**
3	Q28	.465(.096)	.075	4.83	0.004**
4	Q28b	.279(.083)	.053	3.39	0.004**
5	Q29	.273(.115)	.042	2.37	0.001**
6	Q30	.527(.108)	.075	4.85	0.002**
7	Q31	.022(.125)	.032	.179	0.858
8	Q32	.443(.104)	.065	4.24	0.003**
9	Q33	1.582(.139)	.228	11.34	0.002**
10	Q34	.585(.109)	.084	5.34	0.003**
11	Q43	.223(.101)	.041	2.22	0.023*
12	Q46	.625(.097)	.106	6.47	0.004**
13	Q47	.708(.123)	.091	5.75	0.004**
14	Q48	.572(.104)	.087	5.52	0.004**
15	Q49	.750(.124)	.098	6.07	0.003**
16	Q50	.248(.108)	.042	2.30	0.022*
17	Q51	.485(.088)	.087	5.50	0.001**

18	Q54	.362(.113)	.051	3.21	0.001*

Demographic factors were controlled for in each regression. Demographic factors were controlled for in each of the regressions, *Significant at 5% (p<.05)

The result shows that among the 17 organism factors considered, 16 have a significant impact ($p<0.05$). In contrast, only Q31 does not significantly impact the use and adoption of the USSD technology ($p =.858$, $p>0.05$). The result also shows that among these organism factors, Q26 reported the highest coefficient of determination of .408 which implies that the factor (Q26) explained the higher percentage of the variation in the use and adoption of USSD technology than other organism factors. Also, Q26 was found to have the highest t-calculated value of 17.92, which implies that this factor is the most significant organism factor with the most significant positive impact on the use and adoption of the USSD technology ($p<0.05$).

5.4.4 Summary of Significance Level with Research Hypothesis

Based on the statistical analysis and analysis of the significant contribution level of each of the constructs, as shown in Table 5.12 – Table 5.14, a summary of the significance level of the constructs is presented in Table 5.15. From the statistical analysis, all components hypothesised have an acceptable level of significance and they cumulatively impact the adoption of USSD technology adoption for digital financial services in Nigeria.

Table 5.15: Significance Level of Contribution of the Framework's Construct

Stimulus	Construct	Test Factors	∑ P < 0.05 (5% significance)	Significance Level of Contribution
Hypothesis 1	**Design**	USSD technology design will positively impact the motivation to adopt DFS	P < 0.05	Highly significant
Hypothesis 2	**Security**	USSD technology security will negatively impact the motivation to adopt DFS	P < 0.05	Highly significant
Hypothesis 3	**Information Quality**	USSD technology information quality will positively impact the motivation to adopt DFS	P < 0.05	Highly significant

Hypothesis 4	**System Quality**	USSD technology system quality will positively impact the motivation to adopt DFS	P < 0.05	Highly significant
Organism	**Construct**	**Confirmatory Test**	**∑ P < 0.05 (5% significance)**	**Level of Significance**
Hypothesis 5	**User Experience**	USSD technology user experience will positively impact consumer use of DFS	P<0.05 (0.004)	Significant
Hypothesis 6	**Perceived Usefulness**	USSD technology's perceived usefulness will positively impact consumers to use of DFS	P<0.05 (0.004)	Significant
Hypothesis 7	**Perceived Risk -**	USSD technology perceived risk will negatively impact consumer use of DFS	P<0.05 (0.004)	Significant
Hypothesis 8	**Perceived Trust**	USSD technology perceived trust will positively impact consumers to use ofDFS	P<0.05 (0.004)	Significant
Respond	**Construct**	**Confirmatory Test**	**∑ P < 0.05 (5% significance)**	**Level of Significance**
Hypothesis 9	**Intention to Use**	Consumers intention to use USSD technology for DFS will positively impact derived satisfaction	P < 0.05	Highly significant
Hypothesis 10	**Satisfaction**	Organism factors will positively impact satisfaction derived by customers in using USSD technology for DFS	P < 0.05	Highly significant

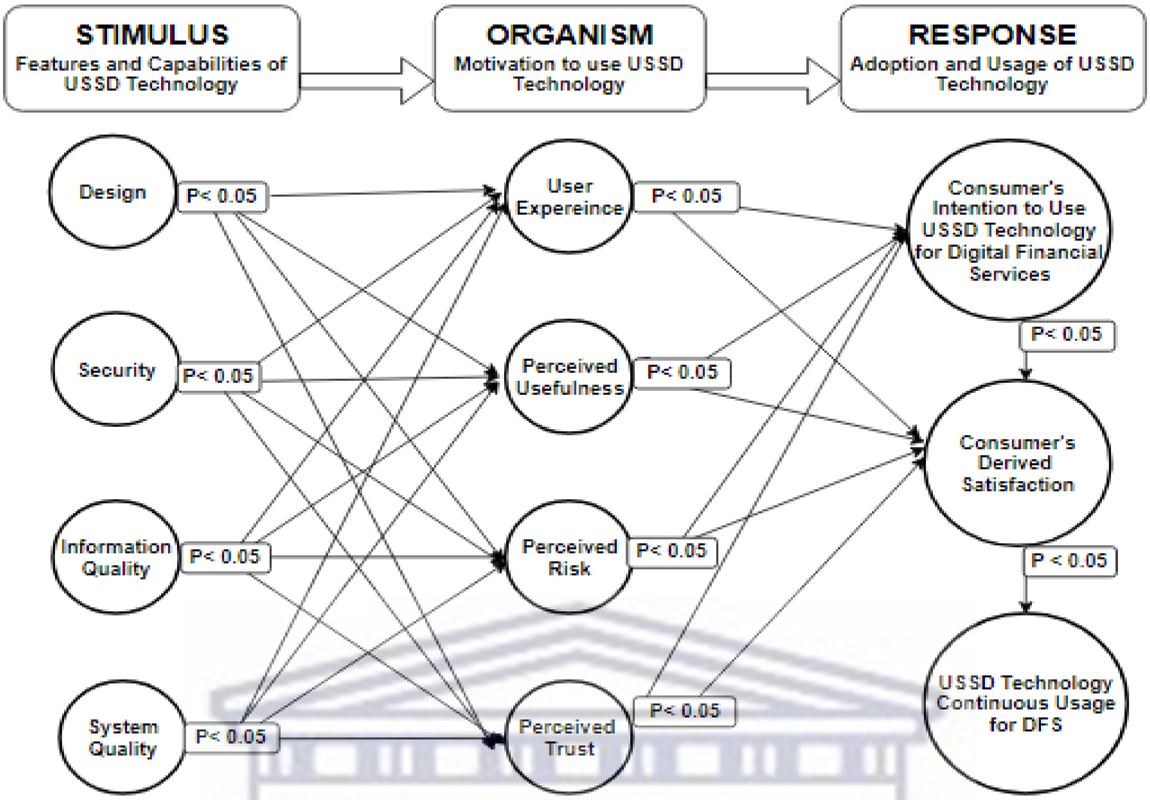


Figure 5.11: Significance Level of Factors for USSD Technology Adoption

5.5 Chapter Summary

This chapter presents the quantitative results of the study. The study recorded an 85% response rate. Results from the factor analysis indicate a positive correlation of all variables in the instrument. From the gender and demographic analysis of the study, results indicate a higher uptake of USSD technology adoption for digital financial services among males than females, predominantly within the 18-35 age bracket and primarily at tertiary-level education. Similar research on gender differences in adopting USSD technology suggests that males tend to adopt the technology more rapidly than females. Regression analysis results to determine each variable's correlation coefficients to the study indicate that there is a significant impact of the stimulus factors (features and capabilities of the USSD technology) and organism factors (motivating factors for using USSD technology) on the adoption and use of USSD technology for digital financial results.

However, the contribution was reduced after factoring in the contribution of stimulus factors, as shown in Table 5.18. The joint contribution of stimulus and organism factors was significant (F-cal. = 45.744, p-value =0.000, p<0.01, Model 3), implying that the null hypothesis is rejected. Therefore, there is a significant impact of the stimulus factors (features and capabilities of the USSD technology) and organism factors (motivating factors for using USSD technology) on the adoption and use of USSD technology for digital financial results also reveal that stimulus factors have a more significantly positive contribution to the use and adoption of the USSD technology than organism factors. Further analysis was carried out to determine which stimulus factor significantly influences the use and adoption of the USSD technology, and the result indicates security, risk, system quality, and transaction cost.

The summary of the results suggests that all seventeen variables (out of the ten themes of the USSD technology adoption framework) have significant interdependencies of factors considered for this study based on the results presented in this chapter, and they directly influence USSD technology adoption. The next chapter presents the qualitative results.

CHAPTER 6 - DIAGRAMMATIC OVERVIEW

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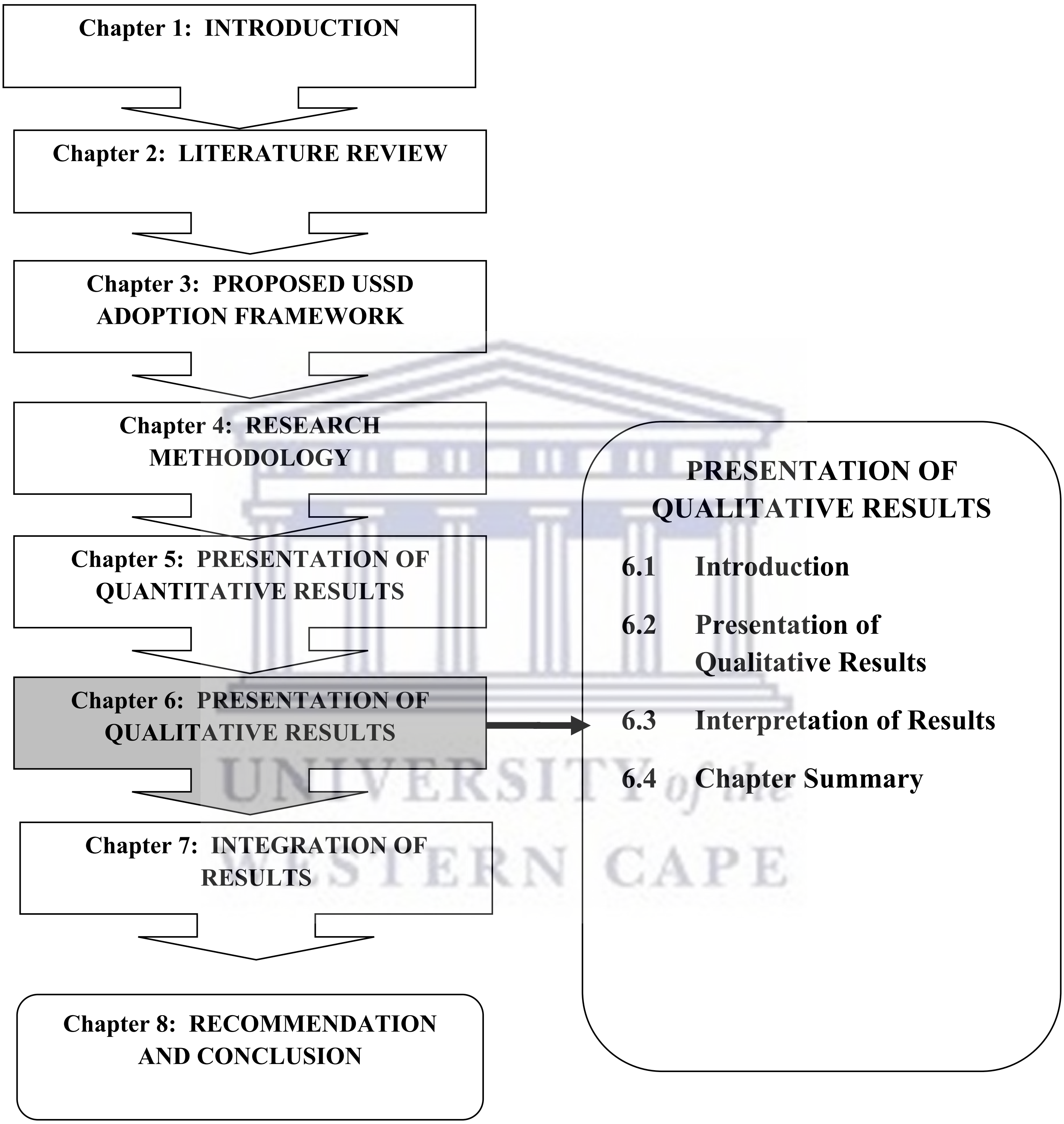

CHAPTER 6- PRESENTATION OF QUALITATIVE RESULTS

6.1. Introduction

As discussed in chapter four of the study, a sequential explanatory mixed methods design was used to investigate the USSD technology adoption framework and determine how to improve USSD technology adoption for digital financial services in Nigeria. In line with previous literature discussed in section 4.5 of the study, the sequential explanatory mixed method requires the completion of the quantitative data collection and analysis phase. After that, qualitative data collection and analysis would begin using quantitative analysis results to develop a semi-structured questionnaire to perform qualitative analysis. This also aligns with the views of Theodoru (2013) that the sequential explanatory mixed method is a two-phase strategy popularly used in research that requires a multidisciplinary approach with complex variables. Typically, it requires the sequential collection and analysis of data to explain the confluence of the outcome of investigating a research problem in greater depth (Ugwu et al., 2021).

Scholars (Hamilton, 2018; Theodorou, 2013) also opined that the sequential explanatory mixed method allows for a general understanding of the research problem to be gained through the use of quantitative data, which is then followed by the ability to validate the dependability of statistical results through the use of the qualitative method in a complex environment, sequentially (Creswell and Plano Clark, 2011). Identifying USSD technology as a systematically important channel in the Nigerian digital financial services ecosystem with oversight from two key regulators (the Central Bank of Nigeria and the Nigerian Telecommunication Commission) introduces some complexities. These complexities exist because the mobile network operators (provide a USSD network for consumers to initiate USSD-based transactions) and digital financial providers (who are also MNOs' customers but use the USSD channel to deliver digital financial services to consumers).

Based on the complexities of the Nigeria DFS ecosystem, as discussed in Chapter 2 of the study and with the background of the importance of this chapter where results of the qualitative analysis are discussed, the qualitative analysis phase ensures the credibility of the results obtained in the quantitative analysis phase. According to scholars (Toyon, 2021; Younas et al., 2023), qualitative research is the process of formulating research questions and developing methods for gathering sources of evidence from participants, followed by data analysis and interpreting what the findings indicate. It is more exploratory and requires insights into reasons, beliefs, views, and motives about a phenomenon to be acquired by combining research results and knowledge base from subject matter experts within areas of research interest (Creamer, 2017). It complements recommendations made towards how USSD technology adoption can be improved. It also provides subject matter expert opinion by engaging relevant stakeholders in the banking and telecommunication industry to validate the quantitative data results to produce more comprehensive results. This also helps to give more expansive views on how USSD technology adoption decision-making and service provisioning within a complex digital financial service ecosystem can be improved.

The quantitative analysis results based on the USSD technology adoption framework constructs revealed that 33 questions were derived using a questionnaire. This cut across respondent personal information (demography, age, and occupation), and other questions were distributed across three themes of the USSD technology adoption framework, which include stimulus factors (features and capabilities of the USSD technology) and organism factors (motivating factors for using USSD technology) on the respond (adoption and use of USSD technology) for digital financial services in Nigeria. The results indicate that all the factors have a significant level ($p<0.005$) to affect USSD technology adoption. The demographic section used in the quantitative analysis was not considered in the qualitative interview process to accomplish the qualitative analysis phase.

Using both the results obtained in the quantitative step and suggestions by respondents who are the ultimate recipients of USSD technology-based services, a semi-structured questionnaire was developed (Appendix II) across eight themes that form the basis of the USSD technology adoption framework components. (i) **Technical design**: includes interactiveness of the USSD solution, clarity and simplicity in using it to perform digital financial services (ii) **Security :** is the reliability, safety, and privacy in using USSD technology to perform digital financial services (iii) **System quality:** is a measure of the performance of USSD technology for digital financial services measured in terms of functionality, reliability, data quality, flexibility, system accuracy and capability (iv) **Information quality:** is a measure of improved authentication and efficient processing (v) **User Experience (UX):** is the perception, feelings, motivations, and values as a result of using USSD technology for digital financial services (vi) **Perceived Usefulness**: is the extent to which an individual believes that using USSD technology will enhance their tasks and continuous usage in performing financial services (vii) **Perceived Risk**: is the tolerance of risk, anxiety, concern, discomfort and uncertainty during the use of USSD technology for digital financial services (viii) **Perceived Trust**: is the trust in the service provider to prevent authorized access to their account and financial transaction details when using USSD technology.

After conducting interviews with 18 (eighteen) senior managers and subject matter experts in the Nigerian banking industry and 2 (two) from the telecommunication Industry, making a total of 20 (twenty), all analyses were based on their responses. In the case of qualitative data, we first defined the overarching themes that applied to each of the goals with remediation suggested by customers in the quantitative phase. The study then summarised these topics using frequency distribution to identify the principal theme pertained to each objective.

6.2. Presentation of Qualitative Results

The qualitative findings contributed to a better understanding of the specific socio-economic, cultural, or infrastructural factors influencing USSD adoption for digital financial services in the Nigerian context. This section presents the results of the qualitative analysis of the study. Using a semi-structured interview to obtain validation data regarding the outcome of the quantitative analysis, the section presents an additional lens to understand the opinions of industry experts on the importance of constructs of the USSD technology adoption framework in performing digital financial services.

6.2.1 USSD Technology Adoption Framework Construct

6.2.1.1 Stimulus (Features and Capability of USSD Technology)

With regards to whether the technical design of the USSD Platform is contributing to its adoption and usage for digital financial services in Nigeria, 66.7% of the experts interviewed were affirmative, while 33.3% of the respondents were not. One of the interviewees (SA) was affirmative and opined that:" So, that simplicity of integrations makes it a bit easier because to connect it is effortless," while another interviewee (AA) "In terms of consumers choice, it's one of the fastest means of making transfers today. And you know consumers easily key into anything fast". Regarding the safety of USSD technology from scams and fraud, SO opines that "*It is safe if there is no compromise, forceful or compulsion to disclose your information to anybody. Only when you are forced to disclose your password and know some of these things the emphasis is on the two-factor authentication service. You cannot use another phone number different from the one you used to register on your BVN at your bank to do this transaction"*. INT (06) observed that to an extent, no. INT (06) added that "*As I said, security to a large extent replies to the customer. Though the financial institutions have a role to play regarding security, the effectiveness of their security is subject to the customer*".

6.2.1.2 USSD Technology Security

On the security of the USSD Technology, one of the interviewees posited that while some banks will request that one needs a card to create the USSD pin, others do not. The interviewee then concluded that it is the least secure because anybody can pick up one's phone, and as long as they know the code, they can access one's account. To him, it is less secure compared to other channels. However, because it doesn't have additional security levels, one still needs a user PIN to transfer money, which could be safer. However, one can use, for example, an MTN yellow account, which is a Diamond account initially linked to MTN; one probably just needs a phone number to enrol to be able to make small transactions on it, so it is less secure compared to other channels the lower level of sufficiency and security is what has made the USSD not to be in the mainstream popularity and the fact that it carries low ticket transactions.

The importance of more education/ enlightenment among USSD technology users was also mentioned by the interviewee, INT (02), who believes it is probably the easiest way when it comes to scams and fraud because while he was at the branch, they usually receive so many calls from customers that they received a text from this person telling them to dial this code to do this and do that and that they will get this and get that. INT (02) opined, "*Since the demographics of people using USSD codes are mostly uneducated people from the rural areas, it is easier to take advantage of them, and since it is not sophisticated doing what they request them to do, they quickly do it. This makes people on the USSD more vulnerable*". The need to secure users' PIN was also recommended by INT (08) that "*If the PIN is compromised, anything can happen; hence, a USSD can be compromised the same way a mobile app can be compromised. Just as a person can pick up one's phone, the person can also have access to one's bank details. For example, if one is doing me to me airtime purchase, one doesn't need to input any pin, but if purchases have for this party, one will need to input it to progress*". This, therefore, implies that every USSD technology user needs to safeguard their PIN before, during, and after transactions. Another interviewee's opinion, INT (03), believes that the USSD technology is safe if there is no compromise, forcefulness, or compulsion to disclose one's information to a third party.

On what can be done to safeguard bank customers from fraud, INT (01) also mentioned that this could be done when users maintain PIN secrecy by constantly changing the PIN occasionally. INT (01) stressed that "*PINs should have an expiration date and require changing at least monthly even though it might be tasking because it can be forgotten. However, the bottom line is that it will help to know if the current pin has been compromised and one is unaware. So, if a person knows your PIN and tries to use it, they will not be successful because it has been changed. It could be weekly or monthly"*. Transaction limits were also mentioned as one of the ways of addressing the challenges of USSD technology. This is the opinion of INT (03) that the solution to security and fraud challenges associated with USSD technology is to limit some transactions. He recounted an experience he once had in one of the GSM solutions he managed some time ago. He had some fraud, and he had to understand how the fraud happened.

A respondent who is also a subject matter expert opines, "*When one puts out a system, a fraudster will try it out to see if there are loopholes, and they will Start using it. He discovered the fraud happened almost immediately after the user found out the usage service on the USSD services, so he* *was to place a limit on the transaction on the first three days so that a customer cannot go beyond a particular amount for the first three days"*.

6.2.1.3 USSD Technology Information Quality

The information quality of the USSD technology, INT (08), while commenting on the need to maintain the secrecy of information, INT (08) says, "How reliable a digital financial service is dependent on how one can protect oneself. If one doesn't compromise details, one is safe to a great extent. Unfortunately, one finds people giving their details to third parties or fraudsters". A respondent and subject matter expert (MI) also suggested the creation of more awareness among users of USSD technology. They posited that this would help minimize fraud incidence among users of this technology. One of the interviewees opined that "sometimes these fraudsters are family members. So basically, banks need to make people aware of the sensitivity of their bank details. They need to use every avenue they know to create this awareness. A lot of the time, people fall victim to these fraudsters because of greed.

For instance, one knows some didn't apply for the lottery, and they call that you send your details for remittance, and the person gladly gives it to them. Ordinarily, this should signal a red flag. Banks can do so many things to secure us; what is left is up to us. There is a level the banks cannot go beyond". Safeguarding one's device or PIN was suggested to address the security challenges of the USSD technology by INT (03). INT (03) says, "*The best thing for the banking system to be improved, if any of one's device or pin is compromised because any part of the risk of the USSD is non-location specific, it doesn't matter where one is, one can be in America and be transferring but for internet to support this services now is for banks to improve to be able to know the location of the individual to raise a flag that a particular transaction is being consummated from an unusual location. It is more of getting feedback from the end of the customers when any means is used in facilitating USSD when it is compromised and maybe the things needed to improve on and then allow for interoperability beyond the shores of Nigeria*".

This suggestion points to the fact that maintaining the secrecy of the device or pin can help address some of the challenges of the USSD technology. Limiting the amount of transaction was recommended, and INT (06) posits that "*there are many things that can be done such as the secret pin, limitations in terms of amount one can withdraw per session and also pattern recognition*." Though there is room for improvement, it is safe for him now. Another interviewee, INT (04), says the USSD platform is plain text, just like SMS. However, when an SMS is sent out, it will go to a system known as an "SMS gateway" to sit until it can locate the phone and the SMS goes out. In the case of the USSD, there is no gateway where it is going. Once you call up the short code, it goes to the server configured to send that traffic; once a response comes back, the answer is displayed on the customer's phone.

Therefore, authenticating was tricky; one could only encrypt the message at the last mile. The last mile is between the mast, where the traffic was received, and the last aggregator of the banks, but between the phone and the mast, it might be difficult to encrypt the message. Hence, the best form of authentication that can be done is what the banks are already doing, where one has the passwords or a token that, when one enters, one can use to check if one is indeed who they claim to be. Respondent (MI) doesn't know what the banks need to do other than what they currently have, such as using biometrics for those who favour that feature and using PIN, which is enough. Another respondent (SO) believes the two-factor authentication should continue, which has worked well for us.

According to him, as much as that works, there is evidence that precautions have been taken against fraud for now. INT (06) says an authentication similar to what is obtainable in Canada, whereby a consumer is expected to say some words to customize such a customer's account, can be adopted in Nigeria. Although he agrees that the system in Nigeria is better than that of many Western countries, INT (07) also argues for adopting the two-factor authentication process. However, he preached that in adopting this method, caution should be taken because one of the selling points of this platform or channel is its ease of use and its acceptability; hence, putting stringent and bulky processes in place might defeat that purpose. However, he thinks implementing two-factor authentication for transactions on the channel will go a long way; for instance, after inputting the PIN, one may be required to input a token generated from a different app.

6.2.1.4 USSD Technology System Quality

The results obtained from the interview on the quality of USSD Technology were also related to the issue of fraud because if there is a high level of information quality, it could help minimize fraud among users. To INT (07), increased education and sensitization is the way to go as INT (07) observes that "there should be an increased sensitization of the customers because it starts with there is a limit to which a bank system can go to in securing a customer's data. If a customer willfully conceives or compromises his data with a fraudster, you will agree that there is little the system can do to curb the situation since the bank has put measures in place to safeguard this, such as the Pin and the like. So, the first thing is that customers should be better sensitized; they should be aware of all the schemes these fraudsters use to engineer or steal information from them". Second-factor authorization was suggested by INT (03).

He opines that one needs to put something else after a PIN to know he has three levels of authentication. He added that "*one should be able to know what one has and what one is. What one knows is the PIN or password; what one has is the token. Anything that you have that is physical so what you have is biometric, so with USSD technology, you can do a mix of what you know and what you have; so that's why in some banks, when you transfer beyond a particular amount, they will tell you to provide a token they will tell you to press a token that the bank has provided for you*". He added that on the USSD service, one could do a higher value, but one has to put in the second-factor authentication. This was the precaution put in place by the CBN when the USSD fraud was becoming too serious.

6.2.2 Organism (Motivation to use USSD Technology)

6.2.2.1 USSD Technology User Experience

The main areas of concern about the user experience also revolved around the security of USSD technology. INT (03) observes that the major challenge is that USSD does not encrypt one's personal information. The interviewee, INT (03), gave an instance that when USSD is dialled with one's bank, one will notice that it is not encrypted. Only the telco will see the fault but not do anything about it. Therefore, because it is not encrypted, the person sitting beside one can know the PIN, and if one happens to be using the same PIN for all transactions, then by understanding one, the whole PIN would have been known by the fraudster. The need for encryption of the USSD technology transaction to enhance its security was also suggested by the interviewee, INT (04). On his part, this interviewee says the first observation he had regarding the safety of the USSD technology is that it is unsafe to transact with because everything is sent in plain text; hence, it is difficult to encode or encrypt whatever is passing through the platform.

For these reasons, deposit money banks limit the amount transacted on the USSD to minimise risk. Maintaining the secrecy of the PIN and constantly changing the PIN have also been recommended to address the issue of the USSD technology being prone to fraud. INT (03) advised USSD technology that "*users do not need to write their PIN or password anywhere. If one does not compromise on all these, there won't be any problem. Furthermore, in case of a stolen phone, it is important one quickly contact one's banker so they can deactivate all transfers from the phone"*. The need for more enlightenment on the use of USSD technology was also observed by INT (03) that "the more people are enlightened on how to carry out transactions from their account and their wallets, the better for them, the less likely for them to be a victim of fraud." Also, people should be discouraged from disclosing their passwords and PINs to others. While recommending possible ways of addressing challenges associated with the USSD technology, one of the respondents advised that "*immediately* *you notice these important personal identities are compromised, it is important you quickly change them either at the ATM or contact your bank to change it for you*."

6.2.2.2 USSD Technology Perceived Usefulness

Qualitative results indicate that perceived usefulness positively impacts consumers' intention to use USSD technology to perform digital financial services. Regarding perceived usefulness in the qualitative analysis, the ubiquity of USSD technology enables customers to use USSD technology to access digital financial services irrespective of their bank; it is the cheapest access channel to access banking services, and it's very convenient and cost-effective compared to accessing DFS within a bank branch and online. Qualitative data through interviews was obtained on possible ways to address the challenges confronting perceived usefulness in using USSD technology, which is largely affordability and USSD session charges. To address this problem, one of the interviewees, INT (03), recommended more collaboration between banks and telecommunication service providers to drive down the USSD session cost. One interviewer for the qualitative analysis explained that the Central Bank of Nigeria and the Nigerian Communications Commissions mediate between banks and telcos to ensure the sustainability of charges passed to consumers so that USSD services can be affordable. In contrast, the service providers will still be afloat in business.

To address the perceived usefulness challenges associated with the USSD technology, INT (01) says: "*Although consumers mostly prefer to access digital financial services through their mobile phones due to comfortability and 24x7 availability to avoid being in a long queue in banking halls, there are some transactions that cannot be accessed through USSD technology due to sensitivity of the proposed transaction or the policy within the bank. This would, in turn, require consumers to visit bank branches. Use another person's code to perform a transaction''. This also aligns with the views of INT (02), INT (03), and INT (05), who agree that "Accessing digital financial services allows consumers to have personal control of their finances, understand their spending pattern, stay up to date on new product and service offering and enable them to reduce the cost of going to bank branches for every transaction to be performed.''*

6.2.2.3 USSD Technology Perceived Risk

Qualitative results indicate that perceived risk negatively impacts consumers' intention to use USSD technology to perform digital financial services due to fraud, theft of mobile phones, insufficient security measures, and loss of funds through USSD channels. From the qualitative data through interviews obtained on possible ways to address the current challenges confronting the use of USSD technology due to perceived risks, one of the interviewees, INT (03), recommended more education on the operation of USSD technology. One interviewer for the qualitative analysis explains that the easiest thing to do is to increase education among people. Secondly, he suggested that since Nigeria is a multilingual country, a feature should include the three core languages so that when anyone dials a code, the code will request the language the person wants to communicate. This made it easier to incorporate the core illiterate into the usage of the USSD.

To address the security challenges associated with the USSD technology, INT (01) says: "*Although no security is 100% guaranteed, however, the fact that one understands that he cannot use another person's code to perform a transaction. However, he suggested that it wouldn't be a bad idea if there could be at least two codes so that when one phone is off, one can easily pick another person's phone, input another code on it to show that one is using another person's phone and use another code on it to carry out whatever transaction one wants to carry out. However, he still went further to say he would not want to have at least three different codes to make a transaction, which seems contradictory"*. The need to increase the dialling codes to two or three as a security measure was also emphasized by INT (02), who says different banks require different processes to open the USSD.

6.2.3 Response (adoption and Usage of USSD technology)

6.2.3.1 Consumer Intention to use USSD technology for digital financial services

For customers' intention to use USSD technology, the authentication and verification information when using USSD technology for digital financial services impacted consumers' intention for its country-wide adoption and usage; all the respondents (62.5%) agreed. In comparison, only 37.5% disagreed, meaning that most respondents agreed that authentication and verification information when using USSD technology for digital financial services impacted consumers' intention for its country-wide adoption and usage. This also corroborates with the result obtained from the quantitative data. Regarding whether the USSD Technology session time and procedures to perform DFS efficiently, 75% of the respondents rated it as efficient, while only 25% opined that it was inefficient. All the respondents (100%) indicated that a friendly user interface improves consumers' intention to use USSD technology, which is also in line with the results obtained from the quantitative data.

All the respondents also indicated that USSD technology's first-time activation to perform digital financial services contributed to its adoption for DFS use (100%). Therefore, based on the qualitative and quantitative data, stimulus factors (features and capabilities of the USSD technology) and organism factors (motivating factors for using USSD technology) impact the adoption and use of USSD technology for digital financial services in Nigeria.

6.2.3.2 Consumer User Satisfaction from using USSD technology for digital financial services

The result revealed that all (100%) of interviewees indicated that the USSD technology was unsafe, though its safety was believed to be predicated on the customer's ability to manage their devices and PINs effectively. The result also revealed that 100% of the respondents agreed that poor telecommunication networks limit the usage and adoption of USSD technology in some parts of the country. Specifically, one interviewee, INT (01), opines, "It's just the problem of Nigeria. Whether it's a 2G, 3G, 4G, or 5G network, it should not affect USSD technology. But because of the poor-quality network we have, it does. What telcos should do is increase their coverage because, most of the time, you notice that the network mast is far from where you are. This limits the network strength. They need to bring these masts closer to enhance network quality," while the options of other respondents were not too different from this opinion. In terms of whether USSD outperforms Internet banking regarding functionality, system accuracy, and overall quality, 100% of the respondents disagreed

6.3 Interpretation of Results

6.3.1 Challenges from Qualitative Analysis

The qualitative data obtained from the interview revealed that five major themes were identified as the major challenges confronting users of USSD technology. These include the user interface, which 37.5% of the interviewees went for, while other themes were network issues (50.0%), fraud (25.0%), high charges (50.0%), and insecurity (50.0%). Practically one of the interviewees (INT 01), while identifying the problem of the user interface, posited that: "*Sometimes when one dials the code one comes across long options and in the process of trying to read through the options the time will elapse."* This opinion on the problem of the user interface of the USSD technology was also supported by another interviewee (INT 002): "*The first thing that comes to mind is time-out issues while carrying out a transaction on one's phone, and one is not promoted before you know it within 6-10 seconds it drops and you have to begin the transaction all over again. These kinds of complaints are received regularly, especially from those who don't want to go through the stress of pestering one person or another while doing the transaction, one just sees time an error or something, and another problem experienced again is downline from the telcos*".

Data obtained from the interviewee also showed the security challenges confronted by using USSD technology. This challenge was identified by more than half of the interviewees (62.50%). One of the interviewees (INT 01) stressed that "*Some people feel it's not safe enough. Anyone can just access one's phone and dial one's bank code and password, and that's it. It's just one-step authentication.*

Most people feel it should have a second authentication factor". While identifying insecurity as one of the challenges, Interviewee (INT 03) noted that "*One of the complaints centres on fraud. Complaints are still around, so it is a fraud but in a different dimension. Let's assume someone changes phone or loses their phone, or the phone was stolen. Someone can access the account easily by just dialling any of the banks' USSD streams with the code number peculiar to that phone number that's one way".* This was also the position of another that this technology is prone to fraud as the interviewee (INT 04) observed that "*One of the challenges is security because many people complain that they have received a debit alert without initiating a transaction. For instance, somebody gets access to your SIM and goes to do a sim-swap. He then does the transaction using your details*". The security issue was mentioned by almost all the interviewees (INT 07), who noted that; "*Most of the complaints during his time working on USSD revolve around security. The platform's security has been leaking compared to other platforms, such as Internet banking, mobile banking, and maybe chat banking. Take the USSD platform. It is the most porous".*

Some interviewees also identified challenges surrounding the USSD technology network based on the interview results, which is one of the significant challenges of the USSD technology. For instance, INT (02) opined that: "*Sometimes the banks may not have issues, but the networks may be the problem such as when services are down, and one can't make any transactions so people use to come to banks and say your channel is not working whereas the problem at that moment is not from the bank."* Also, another interviewee (INT 03) noted that "*The scuffle between the banks and the telecommunications had made it difficult to understand what is happening, for instance, a situation whereby services just timed out even before they were provided to customers, yet it was difficult understanding who is at fault*." While commenting on the network challenges of this technology, INT (03) opined, "*One of the major problems is that, in many cases, the session times out. Customers' major complaint on USSD centers around outages such as when the session suddenly times out when called or after almost completing the task without getting a response that the transaction has been completed*".

Furthermore, some of the interviewees raised the issue of fraud precisely; INT (03) noted that "*one of the complaints centres on fraud. Complaints are still around, so it is a fraud but in a different dimension. Let's assume someone changes phone or loses their phone, or the phone was stolen. Someone can access the account easily by just dialling any of the bank's USSD streams with the code number peculiar to that phone number that's one way*". Another interviewee (INT 06) identified fraud as the leading challenge by asserting that: "*I believe fraud is the major challenge. That is what first comes to mind since it is usually linked to one's phone number, which is more or less one's phone. Hence, if an intruder gets access to your phone and peradventure steals the necessary details on your account, it is possible for such fellow to defraud you*".

In the area of charges, half of the interviewees identified it as a major challenge of USD technology. One of the interviewees (INT 02) noted the charge between banks and telcos. The respondent believes such an issue should not occur, and probably, more products should have been added to USSD, making people say it is good to use USSD a lot more. Another interviewee (INT 04) mentioned, "*Major complaints centre on charges if there was a rift between banks and telecoms. The telecoms may say when you started, you said you would help us sell airtime, but we noticed that you are using it to do more than just sell airtime, so you come and pay us for the session you are using on our network*". This is also corroborated by the opinion of INT (05) and INT (08), which also identified high charges as one of the problems in USSD technology. From the qualitative interview, the major challenges reported include unfriendly user interfaces, network issues, susceptibility to fraud, high bank charges, and insecurity about performing bank transactions on USSD. This aligns with the quantitative findings reported around challenges facing the adoption of unstructured Supplementary Service Data (USSD) technology for digital financial services in Nigeria.

6.3.2 Overriding Themes on Remediation to USSD Technology Adoption Challenges

The descriptive analysis of the responses of the interviewees revealed that 50.0% of the respondents indicated increased education/more sensitization and enlightenment, 12.5% went for the introduction of multilingual features in Nigeria's three major languages, 12.5% recommended more than one dialling code, 37.5% went for the encryption of USSD users' information. In comparison, 75.0%, 25.0%, and 50.0% of the respondents went for constant changing of the PIN and maintaining the secrecy of the PIN and device, limiting the number of transactions, and introducing more than one level of authentication. From these results, it is deduced that most respondents focused more on addressing the security challenges of the USSD technology. At the same time, only one recommendation was related to improving the platform's user interface.

6.3.3 Summary of How Qualitative Results Impact Research Hypothesis

Based on the interview response analysis, as discussed in sections 6.2 and 6.3, a summary of the significance level of the constructs for the qualitative analysis is presented in Table 6.1 and as shown in Figure 6.1.

Table 6.1: Significance Level of Contribution of the Framework's Construct

Stimulus	Construct	Test Factors	Significance Level of Contribution
Hypothesis 1	**Design**	USSD technology design will positively impact the motivation to adopt DFS	High- Yes
Hypothesis 2	**Security**	USSD technology security will negatively impact the motivation to adopt DFS	High- Yes
Hypothesis 3	**Information Quality**	USSD technology information quality will positively impact the motivation to adopt DFS	High- Yes
Hypothesis 4	System **Quality**	USSD technology system quality will positively impact the motivation to adopt DFS	High- Yes
Organism	**Construct**	**Confirmatory Test**	**Level of Significance**
Hypothesis 5	**User Experience**	USSD technology user experience will positively impact consumer use of DFS	High- Yes
Hypothesis 6	**Perceived Usefulness**	USSD technology's perceived usefulness will positively impact consumer to use for DFS	High- Yes
Hypothesis 7	**Perceived Risk -**	USSD technology perceived risk will negatively impact consumer to use for DFS	High- Yes
Hypothesis 8	**Perceived Trust**	USSD technology perceived trust will positively impact consumer to use for DFS	High- Yes
Respond	**Construct**	**Confirmatory Test**	**Level of Significance**
Hypothesis 9	**Intention to Use**	Consumers intention to use USSD technology for DFS will positively impact derived satisfaction	High- Yes

Hypothesis 10	**Satisfaction**	Organism factors will positively impact satisfaction derived by customers in using USSD technology for DFS	High- Yes

6.4 Chapter Summary

This chapter presents the qualitative research results using semi-structured interviews to elicit information on each of the thematic areas of the study. Results from the interview with industry subject matter experts indicate that all the constructs for the USSD technology adoption framework are essential in the decision-making process to improve USSD technology adoption for DFS in Nigeria. Also, from the qualitative results, five major key areas were pronounced on service providers' and regulators' watch lists. These are user interface, network issues, fraud, high charges, and insecurity. These results from the qualitative data corroborate those obtained from the quantitative data. Results from the quantitative analysis presented good security measures/authentication processes as one of the primary ways of addressing the problem of USSD technology aside from reducing bank charges.

This is based on findings from the qualitative interviews, where almost all the recommendations focused more on addressing the security challenges of USSD technology. Interestingly, none of the interviewees mentioned the issue of charges. This can be explained by the fact that security is more paramount to them than other challenges, as security lapses may predispose them to become victims of fraud and thereby lose their hard-earned funds.

CHAPTER 7 - DIAGRAMMATIC OVERVIEW

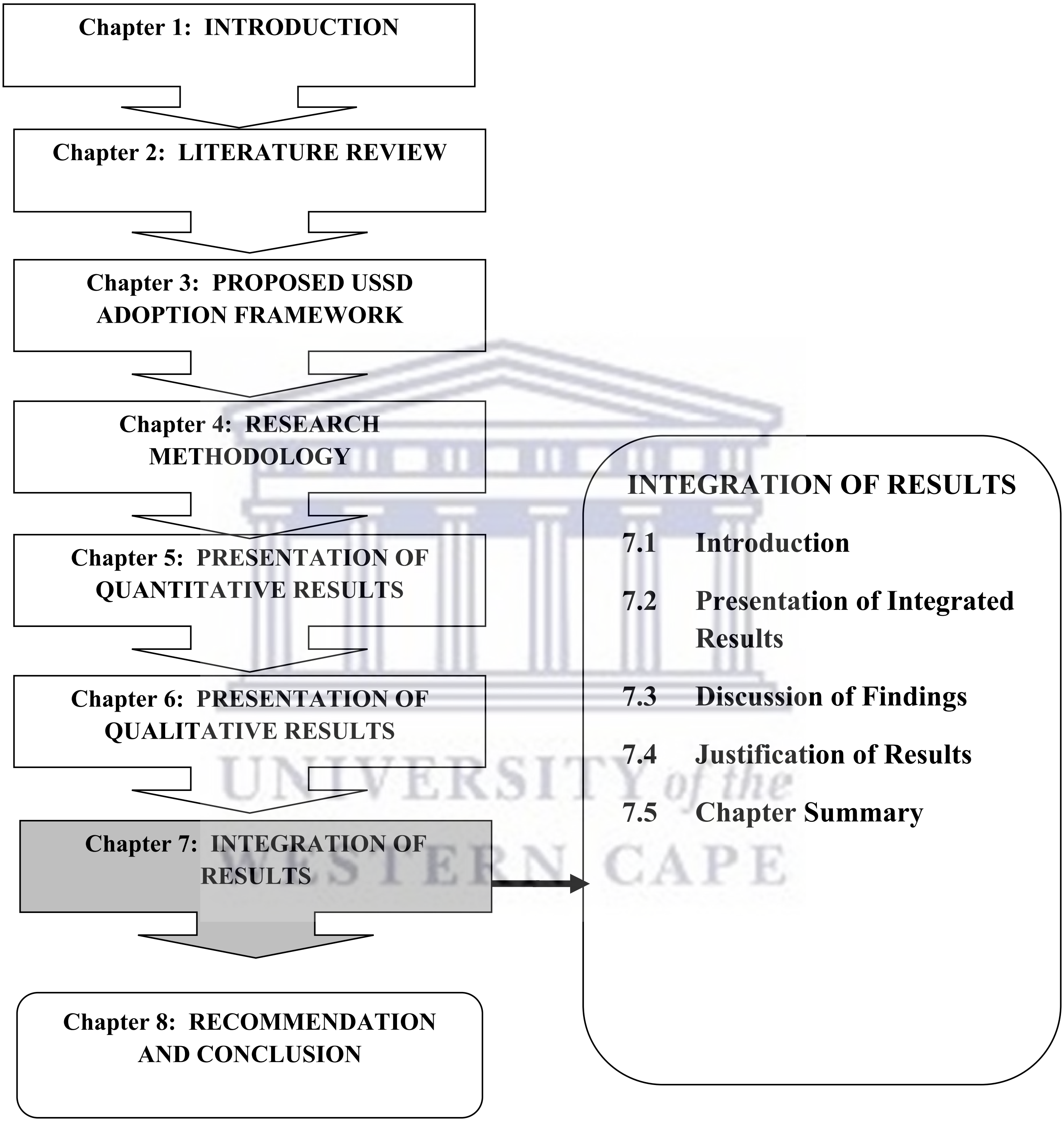

Figure 7.0: Diagrammatic Overview of the Integration of Results

CHAPTER 7- INTEGRATION OF RESULTS

7.1. Introduction

Chapter 4 describes how theoretical and methodological purposes are at the foundation of triangulation-based research. In addition, a USSD technology adoption framework was developed and hypothesised using constructs of the proposed framework to improve USSD technology adoption for digital financial services in Nigeria, as discussed in previous chapters. The study investigated how stimulus factors (features and capabilities of the USSD technology) and organism factors (motivating factors for using USSD technology) will affect the adoption and use of USSD technology for digital financial services in Nigeria. The study adopted a mixed-method research strategy involving quantitative and qualitative analysis. Results of both quantitative and qualitative analysis were presented and discussed in chapter 5 and chapter 6, respectively. Both results examined the challenges of Unstructured Supplementary Data Service (USSD) technology adoption for digital financial services in Nigeria and how the current challenges in using USSD technology for digital financial services in Nigeria can be addressed.

In this chapter, we focus on linking the outcome of the quantitative and qualitative research, a central way scholarly understanding in a given area can be extended through explanatory sequential mixed methods. This allows quantitative analysis to be done, followed by qualitative analysis. This chapter integrates the two results (triangulation) to derive a meaningful and exhaustive research outcome (Turner et al., 2017). This chapter presents the results of combining quantitative research results (survey) utilising a standardized questionnaire and the findings of the qualitative study (semi-structured interview). The results were triangulated to create relevant, trustworthy, and credible results. Triangulation is a research method where findings from multiple data sources are gathered to gain a more comprehensive understanding of the research topic.

This method helps increase the validity and credibility of research findings presented in Chapter 5 and Chapter 6. Section 7.2 presents the integrated results, 7.3 discusses the study's findings, 7.4 provides a justification, and the chapter summary is presented in 7.5.

7.2. Presentation of Integrated Results

Having discussed the importance of triangulation in Chapter 4 of the study, this section presents an analysis of areas of convergence of both quantitative and qualitative results. Furthermore, the section corroborates the findings of the quantitative and qualitative results to derive similarity of conclusions.

7.2.1 Based on Research Constructs

7.2.1.1 Stimulus (Features and Capability of USSD Technology)

7.2.1.1.1 USSD Technology Design

Results of quantitative data obtained through the questionnaire showed that most respondents rated the USSD technology's design as very simple, easy to learn and navigate. This is also corroborated by the qualitative data findings, which indicated that the ease of the design of USSD technology is one of the major factors responsible for its adoption and usage for digital financial services in Nigeria. One of the interviewees (SA) mentioned explicitly that "the *simplicity of the design of the USSSD technology makes it a bit easier because connecting it is effortless*". Another customer interviewed stressed that in terms of choice, the USSD technology is the fastest means of making transfers today with a moderate level of risk except due to negligence in handling information or forceful disclosure of information. This implies that the USSD technology was rated high in terms of design.

7.2.1.1.2 USSD Technology Security

All the interviewees agreed that the USSD technology is prone to scams, which may be due to users' negligence, like sharing the personal identification number (PIN). Some of the interviewees posited that the USSD technology is less secure compared to other channels of banking. In a bid to resolve the security challenges associated with USSD technology, some interviewees emphasized the need for more education and enlightenment amongst USSD technology users, setting transaction limits and occasional changes in PIN by users to maintain its secrecy. Similarly, the respondents obtained from the qualitative interviews also agreed with that obtained through the quantitative step. The security challenges associated with using USSD technology were also acknowledged by respondents who participated in the survey, as most respondents indicated that several people had been scammed by using the USSD technology and that USSD technology is prone to fraud. Therefore, the two research inquiry methods have shown that security challenges are associated with using USSD technology.

7.2.1.1.3 USSD Technology Information Quality

Results from the quantitative analysis revealed that USSD customers have no issues with the quality of information on USSD platforms. The customers indicate that the information is always accurate, that USSD caters to all their needs, and that USSD has a straightforward procedure. However, customers are not delighted with poor customer service from banks regarding USSD platforms and high bank charges. From the qualitative study, it was established that generally, there is no issue with the quality of the information on USSD technology, and the quality of information, as opined by some interviewees, depends on how the users can protect themselves. One of the interviewees maintained that “If one doesn't compromise details, one is safe to a great extent. Unfortunately, one finds people giving their details to third parties or fraudsters". One interviewee opined, "Sometimes these fraudsters are family members. So basically, banks need to make people aware of the sensitivity of their bank details”.

Therefore, an urgent awareness creation was advocated, and what is left is up to us. There is a level the banks cannot go beyond". To address any compromise in the information quality of USSD technology, banks should improve the quality of their systems. Two-factor authentication has also been advocated, including biometric authentication or using a unique SIM card number, as is practised in developed countries. The results obtained from the data sources were consistent; therefore, effort should be made to address the possibility of compromise in the USSD information quality by creating more awareness of two-factor authentication, including biometric authentication.

7.2.1.1.4 USSD Technology System Quality

The study established some system challenges associated with USSD technology from the quantitative data. Some of these challenges include the fact that the USSD technology breaks down frequently (62.4%), the system has failed multiple times, the system fails numerous times, and the technology is breaking down frequently. Hence, the respondents advocated an improvement in the up-time of the USSD service and good quality of network connectivity. This was inconsistent with the qualitative results as there was no specific mention of any issue regarding the system quality.

7.2.2 Organism (Motivation to use USSD Technology)

7.2.2.1 User Experience

Based on both quantitative and qualitative data analysed, the critical areas of concern about the user experience also surround the USSD technology's security. INT (03) observed that the major challenge is the fact that USSD does not encrypt one's personal information. Another interviewee, INT (03), gave an instance where, when USSD is dialled with one's bank, one will notice that it is not encrypted. Only the telecommunication company will see the fault but not do anything about it. Therefore, because it is not encrypted, the person sitting beside one can know the PIN, and this is one of the reasons why some of the interviewees suggested the encryption of the USSD technology transaction to enhance its security. From the qualitative perspective, the experience of the users of the USSD technology centres on the system's security. However, the questionnaire elicited the users' experience with this technology and found that users were dissatisfied with the USSD technology. Therefore, the users' experience has been mainly due to inadequate customer support.

7.2.2.2 Perceived Usefulness

From the integration of both quantitative and qualitative results for perceived usefulness, the perceived usefulness construct positively impacts consumer's intention to use USSD technology to perform digital financial services. From the quantitative results, the customers embrace the ubiquity of USSD technology to access other digital financial services irrespective of their bank; they also agree that USSD technology is cost-effective compared to accessing DFS within a bank branch and using the Internet. The only concern raised was the charges or transaction fees issue, which brings curiosity about affordability. Findings from the quantitative results also align with the responses from the interview. From the qualitative results, perceived usefulness positively impacts consumers' intention to use USSD technology to perform digital financial services. USSD technology ubiquity enables customers to access digital financial services irrespective of their bank.

It is the cheapest access channel to banking services and is cost-effective compared to accessing DFS within bank branches and online. From both results, the affordability of bank charges, especially for people with low income, remains a challenge that needs to be looked into by relevant authorities.

7.2.2.3 Perceived Risk

Results obtained from the survey showed that most USSD technology users who participated in the study observed that USSD technology is open to fraud, while very few complained that using a 4-digit PIN in plain text discourages using USSD for banking. This is also established from the interview results, and several recommendations were made to address this fraud challenge while using the technology. Some of these include the introduction of at least two codes so that when one phone is off, one can easily pick another person's phone, input another code on it to show that one is using another person's phone, and use another code on it to carry out whatever transaction one wants to carry out.

7.2.2.4 Perceived Trust

With regards to trust, all of the respondents interviewed agreed that the users trust the USSD technology. The interview results also showed that all interviewees indicated that USSD technology quality of services by service providers (banks and telcos) significantly contributed to user adoption of USSD technology to perform digitally. The questionnaire results revealed that USSD technology had built confidence in its usage (76.3%), affected their trust, and improved their loyalty to banking services. This result shows that most respondents generally intended to use USSD technology for digital financial services. This indicates that despite the challenges of the USSD technology, the two groups have shown that the users have confidence in using the Technology.

7.2.3 Response (adoption and Usage of USSD technology)

7.2.3.1 Consumer Intention to use USSD technology for digital financial services

Quantitative data showed that user experience, perceived usefulness, perceived risk, and perceived trust significantly impact the use of USSD Technology for digital financial Services. Stimulus factors were found to be significant predictors of the use and adoption of USSD technology. This is also corroborated by the results of the qualitative data, which also pointed out that these factors influence consumer intention to use USSD technology for digital financial services. Qualitative data showed that the authentication and verification information when using USSD technology for digital financial services impacted consumers' intention for its country-wide adoption and usage. Most respondents agreed that authentication and verification information when using USSD technology for digital financial services impacted consumers' intention for its country-wide adoption and usage. This also corroborates with the result obtained from the quantitative data. More than half of the respondents were affirmative regarding whether the USSD Technology session time and procedures to perform DFS efficiently.

All the respondents indicated that a friendly user interface improves consumers’ intention to use USSD technology, which is also in line with the results obtained from the quantitative data. All the respondents also indicated that USSD technology's first-time activation to perform digital financial services contributed to its adoption for DFS use (100%). Therefore, based on the qualitative and quantitative data, stimulus factors (features and capabilities of the USSD technology) and organism factors (motivating factors for using USSD technology) impact the adoption and use of USSD technology for digital financial services in Nigeria.

7.2.3.2 User satisfaction

Qualitative data indicated that all the respondents agreed that the USSD technology was unsafe, though its safety was believed to be predicated on the customer's ability to manage their devices and pins effectively. All the respondents also indicated that poor telecommunication networks limit the usage and adoption of USSD technology in some parts of the country. Though most were satisfied with the services rendered, this does not mean challenges were associated with using the USSD technology for digital financial services in Nigeria. These challenges include poor-quality network networks, security issues, and high costs. This is also corroborated by that obtained from quantitative data that the overall quality of the USSD technology is very satisfactory and that it has increased the quality of banking transactions, provided access to other financial services, led to an effective and efficient financial transaction, and gave users greater control over my finances as well as enabled them to carry out more financial transactions among other benefits of the Technology. From these data sources, it is evident that the users are satisfied with the USSD technology.

7.2.4 Integrated Results Based on Research Hypothesis

Based on the triangulated results of the stimulus factors, Table 7.1 presents a summarised integrated result

Table 7.1: Summary of Integrated Results: Effects of Stimulus Factors on Organism Factors

STIMULUS FACTORS	ORGANISM FACTORS
Design	• Ease of navigation positively improves user experience and motivates consumers to use USSD technology. • Using plain text PIN for USSD technology demotivates consumers from using USSD technology.
Security	• SIM swap and fraud-related issues negatively impact user experience and discourage individuals from adopting USSD technology • Due to the sensitive financial information involved in digital financial services, USSD technology used to access banking services is prone to fraud and negatively impacts perceived trust.
Information Quality	• Lack of customer care support and high cost discourage USSD technology adoption.
System Quality	• Poor quality of service has negatively impacted user experience and consumer trust.

Table 7.2: Summary of Integrated Results: Effects of Organism Factors on Consumer's Intention

Organism Factors	Consumer's Intention to Use USSD Technology for Digital Financial Services
User Experience	• Better consumer experience, faster resolution of complaints, and lower transaction costs motivate consumers to adopt USSD technology.
Perceived Usefulness	• The affordability and usability of USSD technology for digital financial services significantly impact perceived usefulness, as shown in section 5 of the study. Banks run expensive infrastructure to build branches for access

	to financial services in many towns, rural villages, and remote cities with limited internet access are still out of these services. In the places where banks are available, people often experience massive queues of people who wait for an extended period to get their financial services done. Poor people in underdeveloped countries usually struggle to afford banking fees and service charges (Mallik et al., 2020a).
Perceived Risk	• As discussed in Section 5, insufficient security measures and loss of funds through USSD channels due to fraud increase significantly impact consumers' perceived risk (Perlman & Wechsler, 2019a). In other words, consumers, specifically some demographic subgroups, primarily female workers who have attained tertiary education and are aged between 18 and 35 years., may be significantly influenced during the use of technology by feelings like anxiety, concern, discomfort, uncertainty, and cognitive dissonance (Luo et al., 2010).
Perceived Trust	• Section 5 of the study also discussed high trust and confidence in using USSD technology to perform digital financial services, which are important if risk and security issues are addressed. System quality, affordability, and fees also induce consumer trust to use USSD technology.

Table 7.3: Summary of Integrated Results: Effects of Organism Factors on Consumer Satisfaction

ORGANISM FACTORS	**CONSUMERS' SATISFACTION WITH THE USE OF USSD TECHNOLOGY FOR DFS**
User Experience	• Consumers would be satisfied if service providers could understand customers (existing and prospective) in terms of customer attitudes, perception, satisfaction, and even psychographics and adopt human-centred design (HCD) principles for them to adopt new technological-based products and services (David-West, 2020).
Perceived Usefulness	• USSD technology provides the most affordable access to digital financial services globally for the low-income population (GSMA, 2022a). It directly influences consumer's satisfaction and behavioural intention to use USSD technology (Venkatesh et al., 2007).
Perceived Risk	• Digital financial services over USSD can be risky if proper cybersecurity measures are not put in place because the USSD packets are transmitted in

	clear text over the out-of-band signalling channel of the Global System for Mobile (GSM) communications standard (Neza et al., 2022) • Combating fraud and security issues would improve consumers' satisfaction with USSD technology for digital financial services. The study results further indicate that using personal identification numbers (PINs) to authorise transactions and display them in plain text remains an opportunity for fraudsters to exploit consumers' bank accounts. This remains a challenge the technology needs to solve. The study outcome on the insecurity of USSD technology also aligns with the views of Mogaji et al. (2020)
Perceived Trust	• Despite the study's results on the usability and accessibility of USSD technology for digital financial services, system quality, costs, and reliability would increase perceived trust and ultimately improve consumer satisfaction.

7.2.5 Overriding Themes to Address USSD Technology Adoption Challenges

Results from qualitative data showed the challenges of the USSD Technology through increased education/sensitization and enlightenment, the introduction of multilingual features in Nigeria's three major languages, more than one dialling code, and encryption of USSD users' information. Other ways from the qualitative data include limiting the number of transactions, reducing the charges, and introducing more than one level of authentication. From the quantitative data, the specific challenges were high charges on the application, mobile network connectivity issues, and prone to fraud. This result also substantiates some of the challenges identified in rating the different aspects of the USSD technology.

To achieve the objective above, deductions were made based on the results obtained from both the survey and the interview. To improve the adoption and usage of USSD technology for digital financial services in Nigeria, based on the qualitative data, the following were recommended:

(i) Reduction in bank charges per transaction (59.5%).
(ii) Introduction of reasonable security measures/ authentication processes (51.5%).
(iii)Ensures a broadly good quality of network connectivity (37.8%).
(iv)Improvement in the up-time of the USSD service (35.0%).
(v) Improvement in the user interface of the platform (29.9%).

From the qualitative data, the following strategies were recommended to enhance the adoption and use of the USSD technology in Nigeria:

(i) The constant change of pin and maintaining the secrecy of pin and device (75.0%)

(ii) The introduction of more authentication levels (50.0%).

(iii) Increased education/more sensitization and enlightenment (50.0%).

(iv) Encryption of USSD users' information (37.5%)

(v) Placing a limit on the amount on a transaction (25.0%).

(vi) More than one dialing code (12.5%)

(vii) Introduce multilingual features in Nigeria's three major languages (Yoruba, Hausa, and Igbo) (12.5%).

Generally, from both quantitative and qualitative results, three major themes were observed as possible ways of addressing the most significant barriers to improving USSD technology adoption, and they are:

a. Risk and Security

- Developing a robust framework and implementation strategies to combat SIM Swap and other fraud-related issues
- Leverage bank verification number (BVN) and national identification number (NIN) to trace fraud-related cases.
- Incentivizing whistleblowers
- Use of advanced encryption technology to ensure non-compromise of a customer PIN
- Further adoption of multi-level authentication for transactions
- Robust framework and policies on PIN management and authorization mechanisms

b. System Quality

- Government investments in increasing awareness/sensitization on the usability of USSD technology and included as part of the payment system strategy 2025
- Introduce multilingual features in Nigeria's three major languages (Yoruba, Hausa, and Igbo)
- Significant investments in GSM network connectivity with an alternative power supply to ensure system uptime and robust service delivery
- Use of Human-centered Design Principles

c. Cost

- Investments in alternative power for base stations in rural areas
- Enforcement of transaction cost cap limit driven by the CBN and NCC
- Government to incentivise investment decisions for network infrastructure across rural areas to ensure affordability and accessibility of digital financial services to the last mile

- Constant mediation on MNO charges with banks, which currently has ripple effects cost passed to end users as charges for using USSD technology

7.3 Interpretation and Justification of Results

As elucidated in the previous chapters of the study, Digital Financial Services (DFS) is a comparatively new financial inclusion breakthrough in developing nations, focusing on USSD technology. DFS utilises widely available mobile phones to facilitate access to financial services for those who lack access to traditional banking services, particularly those residing in rural regions. Banks and non-bank entities offer these services, including mobile network operators and third-party DFS providers (DFSPs). The extent and quality of mobile coverage provided by mobile network operators (MNOs) also play a crucial role in determining the accessibility of digital financial services (DFS) through USSD technology, given that mobile phones are the primary means of accessing these services. After integrating both quantitative and qualitative results, this section presents a systematic interpretation and justification of the study's results based on the research framework's constructs, forming the basis for data collection, analysis, and understanding.

According to Venkatesh et al. (2013), triangulation integrates the quantitative and qualitative research results from different research approaches. As an integral part of academic research, Turner et al. (2017) described triangulation as a beneficial output of sequential explanatory mixed methods because the triangulated results were based on integrating qualitative and quantitative research findings (Turner et al., 2017). Jokonya (2016) also suggests that the mixing of qualitative (in-depth interviews) and quantitative (use of questionnaire/s) assisted in the completeness of the study's results and in making better inferences about how to improve the adoption of USSD technology for digital financial services in Nigeria. The following section provides a review of relevant literature to corroborate the findings of the triangulated results.

7.3.1 Effects of Design on Organism Factors (User Experience, Perceived Usefulness, Perceived Risk, and Perceived Trust) to Motivate the Use of USSD Technology for Digital Financial Services

As discussed in Chapter 2 of the study, the accessibility of digital financial services through mobile phone user interfaces (UIs) is largely contingent upon the availability of mobile coverage, particularly in developing countries where second-generation (2G) GSM technology, characterized by slower (narrowband) connectivity, is prevalent. Most developing nations can access broadband third (3G) and fourth-generation (4G) mobile coverage faster. However, this availability is mainly concentrated in metropolitan and urban regions along national road corridors. Mobile coverage significantly impacts the user interface (UI) of Digital Financial Services (DFS) and the compatibility of mobile phones for accessing DFS (Perlman & Wechsler, 2019a). Using faster mobile broadband technologies is advantageous for smartphone usage, particularly hybrid smartphones designed in a feature phone format.

This technological advancement enables enhanced, superior, intuitive graphical user interfaces using smartphones. Unfortunately, in emerging countries like Nigeria, most consumers in the mobile money sector still use feature phones and rely on Unstructured Supplementary Service Data (USSD) transactions (Shrestha & Tamang, 2023). However, as discussed in Chapter 5 of this study, over 90% of respondents agreed that the USSD platform in the Nigeria DFS ecosystem by design is user-friendly and easy to navigate to perform digital financial services. In the study, the design features include interactiveness of the USSD solution, simplicity and logical progression of tasks without unnecessary repetitions, simplified operations, and task clarity. Findings from the study reveal that USSD platforms are user-friendly for performing digital financial services in Nigeria. This aligns with the views of scholars (Mallik et al., 2020a) who allude to the fact that real-time interactivity when punching the strings on mobile phones and immediate communication with service providers are key design benefits of USSD technology.

Findings from the study show that USSD technology is easy to learn and navigate and saves time in digital financial services. Also, the study reveals that unfriendly user interface design is mainly considered a hindrance to accessing and using USSD platforms by female business owners who have tertiary education and are aged between 18-35 years. From the qualitative results discussed in Chapter 6, the primary user experience, risks, and trust challenges reported include unfriendly user interfaces, network issues, susceptibility to fraud, high bank charges, and insecurity about performing bank transactions on USSD. This aligns with the quantitative findings reported around challenges facing the adoption of unstructured Supplementary Service Data (USSD) technology for digital financial services in Nigeria. The research focused on digital financial services in Nigeria suggests that service providers should understand customers (existing and prospective) in terms of customer attitudes, perception, satisfaction, and even psychographics and adopt human-centred design (HCD) principles for them to adopt new technological-based products and services (David-West, 2020).

7.3.2 Effects of Security on Organism Factors (User Experience, Perceived Usefulness, Perceived Risk, and Perceived Trust) to Motivate the Use of USSD Technology for Digital Financial Services

Building trust through security with consumers is one of the key areas that organizations will need to prioritise when making digital financial services products and services. Security in this research encompasses three dimensions: reliability, safety, and privacy, based on their influence on technology adoption. Despite researchers' views on the usability and accessibility of USSD technology for digital financial services, the study's results reveal that security remains a challenge and limitation for adoption due to perceived usefulness, risk, and trust (Wanuna, 2020). The study results indicate that using personal identification numbers (PINs) to authorise transactions and display them in plain text remains an opportunity for fraudsters to exploit consumer accounts. This remains a challenge the technology needs to solve. The study outcome on the insecurity of USSD technology also aligns with the views of Mogaji et al. (2020), who opined that theft of mobile phones and SIM swap cases are a barrier to broad adoption of this technology for digital financial services since these devices are often linked to bank accounts or offer consumer information.

Wanuna (2020) developed a dynamic knowledge-based authentication model for enhancing the security of USSD banking transactions due to its vulnerability to a six-digit PIN transmitted in plain text. Findings from the research indicate that security is a major challenge in adopting USSD technology. Furthermore, Ismaila et al. (2020) consider security a major concern for users of USSD technology, as it involves sensitive financial information. To address this challenge, service providers can implement security measures to protect user information and transactions. According to the study, improving security can increase user trust and adoption of USSD technology. SIM cards and phones that have been stolen may be used to access accounts and swindle people. SIM swaps are another incident that highlights the security flaws of the USSD system (Hanouch & Chen, 2015). SIM swap occurs when a network user changes their SIM with a new SIM and transfers their data or existing number to the new SIM.

The issue with SIM swaps is that anybody who does not own the phone may go to a cell centre for a SIM change and have access to the owner's data, including bank account details. Other researchers (Mallik et al., 2020a) also allude to the issue of SIM swap and PIN security in using USSD technology as a challenge for further adoption if not addressed by relevant authorities. To corroborate the study's findings, Nigeria recorded over a 35% increase in SIM swap fraud-related issues in 2022, higher than the number of incidents in previous years. This is because financial transactions over USSD are transmitted in clear text over the out-of-band signalling channel of the GSM network, which can be risky if proper cybersecurity measures are not in place. (Otor et al., 2020). This inherent risk is expected to result in a higher occurrence of security breaches, given the growing use of mobile phones as the primary means of delivering financial services to individuals residing in underserved regions without adequate financial infrastructure (Neza et al., 2022).

Furthermore, Neza et al. (2022) suggest that USSD deployments exhibit heightened vulnerability to eavesdropping at the air interface, especially in the context of consumer mobile phones and mobile network operators (MNOs) operating wirelessly. Whereas developed countries have dropped the use of USSD-like designs in favour of the end-to-end encryption (E2EE) concept, the current mobile network model in SSA countries for financial services is outdated and not compliant with the recommended more secure, dynamic, and application-driven environments. Moreover, it is typical that in case of fraud, the consumers are the ones who bear the cost, not the providers.

7.3.3 Effects of Information Quality /Functionality on Organism Factors (User Experience, Perceived Usefulness, Perceived Risk, and Perceived Trust) to Motivate the Use of USSD Technology for Digital Financial Services

Information Quality/Functionality measures the quality of (the IS) outputs (DeLone & McLean, 2002). This can be expressed in improved authentication and efficient processing due to using new payment products and services (Harasim & Klimontowicz, 2013). In support of the study results for information quality and functionality of USSD technology to perform digital financial services, Mogaji et al. (2020) suggest that USSD technology allows for rapid communication between the user and an application, giving the system real-time characteristics without a need for internet access on their phones, it does not store messages on the user's phone, and it is not subject to the same security threats as mobile applications. This provides an easy and convenient mode for many customers in rural areas who may not have access to home internet or banks. USSD does not rely on the internet but on GSM technology, which makes it more suitable than using a mobile app in a country with limited internet access.

The study results show that USSD technology has limitations regarding the types of services and transactions that can be supported due to its simplicity. Despite USSD application ownership by banks to perform specific digital financial services, these services offered through these applications are very much bank-specific, not user-specific, i.e., some banks may offer to pay for utility bills through their USSD applications, while others may not (Mallik et al., 2020a). Contrary to the views of Mallik et al. (2020), banks have recently started creating unique, customized, dedicated USSD-based solutions for their consumers (Otor et al., 2020). According to a World Bank report (The World Bank, 2016), USSD is a simple technology with limited functionality and interoperability limitations, making it difficult to support more complex services. Further, USSD technology may face interoperability issues between mobile network operators and bank service providers. Based on previous research (Butler et al., 2020; Mogaji et al., 2020).

Research has shown a significant challenge in the interoperability of mobile-based financial services such as USSD with traditional-based banking services (perceived usefulness), particularly in markets with multiple mobile network operators and banks. With recent technological advancements, banks can interoperate USSD-based services seamlessly with other bank players using a shared service infrastructure within the country.

7.3.4 Effects of System Quality on Organism Factors (User Experience, Perceived Usefulness, Perceived Risk, and Perceived Trust) to Motivate the Use of USSD Technology for Digital Financial Services

IS researchers argued that system quality is a measure of the impact of the success of adopting the technology (DeLone & McLean, 2002). USSD technology quality in the context of this study is discussed in terms of ease of use, functionality, reliability, data quality, system accuracy, flexibility, sophistication and integration, and real-time system capability (Błach & Klimontowicz, 2021). USSD technology relies on the mobile network infrastructure's availability, security, and reliability. In response to complaints about poor USSD technology quality of service, mobile network operators (MNOs) often raise concerns over potential network congestion and implications for the quality of voice and SMS services (Hanouch & Chen, 2015). From the results, USSD customers indicate that the technology breaks down frequently- thus, it has failed them multiple times- and that using USSD to transact successfully depends on one's location.

It is also evident that USSD customers have no issues with the quality of information on USSD platforms. The customers indicate that the information is always accurate, that USSD caters to all their needs, and that USSD has clear procedures. While over 30% of respondents in the study alluded to USSD-related network congestion with service providers nearing volume capacity, it is difficult for consumers to predict poor service quality and could potentially be detrimental to adoption and usage. Hanouch & Chen (2015) further argue that network connectivity is a challenge against adopting USSD technology, which can affect the reliability and speed of transactions. To address this challenge, banks and other service providers should work with telecommunication companies to improve network connectivity and improve time. Improving network connectivity can increase user satisfaction and adoption of USSD technology.

7.3.5 Effects of User Experience on Consumer's Intention and Satisfaction to Use USSD Technology for Digital Financial Services

User experience is "a person's perceptions and responses that result from using or anticipating a product, system, or service." When comparing the USSD user experience with other mobile-based services like Short messaging service (SMS), SIM Toolkit (STK, a programming environment embedded on the user's SIM card), and mobile internet, the friendliness of the interaction of the USSD interface is not as smooth as STK or mobile internet (Hanouch & Chen, 2015). The study also revealed that poor customer service and high bank charges emanating from using USSD technology for digital financial services s are major user experience concerns. Over 75% of the respondents also indicate that memorising bank-specific USSD strings to access different services where they are multi-banks constitutes a bad experience. Customers are also concerned that the USSD platforms are prone to fraud, indicating that their trust in their banks influences their use of USSD for banking.

Findings from the study also indicate that poor user experience is attributed to poor quality of service from repeated process initiation due to the drop in USSD sessions. Adopting novel technologies powerfully impacts the user experience (Hanouch & Chen, 2015). In a similar view, GSMA (2022b) opined that USSD technology may not always provide a seamless user experience, particularly compared to more modern mobile technologies. Although it can give a good user experience because it is menu-based, GSMA (2022b) argued that it may not be as intuitive or engaging as other mobile technologies (GSMA, 2022b). Additionally, USSD can be impacted by network congestion and signal quality, which can affect the consumer's intention to use USSD technology for digital financial services (GSMA, 2022a). In Ismaila & Yusuf (2020), the unfriendly user interface is one of the challenges of adopting USSD technology. This discourages users from embracing it, and simplifying the interface can improve user experience and increase the adoption rate (Afjal, 2023)

7.3.6 Effects of Perceived Usefulness on Consumer's Intention and Satisfaction to Use USSD Technology for Digital Financial Services

Perceived usefulness refers to the extent to which an individual believes using an information system will enhance productivity. It directly influences attitude toward systems use and behavioural intention to use the system (Venkatesh et al., 2007). From the study results, USSD technology offers several advantages to users, including simplicity, accessibility, and affordability. GSMA (2022) suggests these advantages have made it a popular technology for accessing a wide range of mobile services in developing countries. USSD technology provides the most affordable access to digital financial services globally for the low-income population (GSMA, 2022a). This is supported by the views of Nepal & Nepal (2023) and Olaolu (2022), who opined that usability, user experience, and cost make USSD the preferred technology for performing digital financial services. As proof of its ubiquity and capability to work on the vast majority of phones, researchers (Mallik et al., 2020a) developed a USSD application with banking features for the unbanked populace to use without going through the banking process.

Unstructured Supplementary Service Data (USSD) is a telecommunications service under the control of Mobile Network Operators (MNOs), although offered to banks as a service to enable their consumers to access DFS. It is widely recognized as a crucial component of infrastructure used to provide DFS on a wide range of mobile devices (Hanouch & Chen, 2015). Research also suggests that USSD works on most phones, does not require changes to the SIM or a new SIM (either of which can be complex and often costly steps), and has essential usability and security advantages (GSMA, 2022b; Mogaji et al., 2020; Perlman & Wechsler, 2019a). As discussed in this study, USSD delivers these services cost-effectively without necessitating access to the user's Subscriber Identity Module (SIM) card (Hanouch & Chen, 2015). However, affordability is one of the key benefits of adopting USSD technology, especially in areas where banks run expensive infrastructure to build branches to access financial services; many towns, rural villages, and remote cities are still out of these services.

To address the issue of the 'unbanked' people, governmental and non-governmental groups have implemented a range of strategies in emerging and impoverished nations. Furthermore, individuals residing in economically disadvantaged nations sometimes have challenges in meeting the financial costs associated with banking fees and service charges. In the places where banks are available, people often experience massive queues of people who wait for an extended period to get their financial services done. In addition, poor people in underdeveloped countries often struggle to afford banking fees and service charges (Mallik et al., 2020a).

7.3.8 Effects of Perceived Risk on Consumer's Intention and Satisfaction to Use USSD Technology for Digital Financial Services

In IS research, perceived risk is defined as consumers' perceived risk and risk tolerance that influence their decision (Luo et al., 2010). The potential adverse effects of acquiring a new product or service give rise to a well-known and significant notion in consumer behaviour termed a perceived risk (Ramtiyal et al., 2022). Consumers' perceived risk and risk tolerance has been established to influence their decision (Luo et al., 2010). In research, perceived risk can lead to "perceived psychological risk", which is the consumer's impression of any potential psychological dissatisfaction, pressure, or worry resulting from USSD technology (Ramtiyal et al., 2022). Regarding specific challenges faced by different demographic subgroups, statistics in Table 5.6 report that insufficient security measures, high charges on the USSD platforms, and susceptibility to fraud are identified challenges by primarily female workers who have attained tertiary education and are aged between 18-35 years.

In addition, customers are concerned that the USSD technology used to access banking services is prone to scams and that they are aware of several people who have been scammed on USSD platforms. Perceived risk suggests that consumers may be influenced during the use of technology by feelings like anxiety, concern, discomfort, uncertainty, and cognitive dissonance (Luo et al., 2010). In reviewing the effects of perceived risk on technology adoption, Kelly & Palaniappan (2022) investigated the factors influencing mobile money transaction service adoption in Ghana using a Technology Acceptable Model and Diffusion Theory. The study's findings revealed that perceived risk significantly influences users' decision to use mobile money banking services (Kelly & Palaniappan, 2022).

7.3.9 Effects of Perceived Trust on Consumer's Intention and Satisfaction to Use USSD Technology for Digital Financial Services

Perceived trust is a behavioural belief favouring consumers' intent to use technology. It is a self-belief that the other party will behave responsibly and will not attempt to exploit the vulnerabilities of the user (Jocevski et al., 2020). The importance of trust is heightened when there is a high degree of uncertainty, which can happen when users don't understand where their information is being stored or how it is being transmitted. Trust is another essential stimulus factor influencing the adoption and use of USSD technology for digital financial services. According to a study by Ismaila et al. (2020), users who trust USSD technology are likelier to adopt and use it for digital financial services. Also, Owusu et al. (2018) indicate that users who perceive USSD technology with efficient system uptime and good customer support are more likely to trust its adoption for usage. The results show that affordability around bank charges and usability significantly impact trust (Mallik et al., 2020a).

7.3.10 Summary of Results Testing and Contribution to Achieve Research Objectives

As discussed in Chapter 1 of the study, the research objective is to investigate a USSD technology adoption framework to determine relevant constructs of the framework that will improve USSD technology adoption for digital financial services in Nigeria. The USSD technology adoption framework has been investigated via a mixed-methods research strategy, specifically using both quantitative and qualitative analysis. This approach has been detailed in chapters 5, 6, and 7. The findings of both outcomes have been cross-validated, and a comprehensive examination of prior scholarly literature substantiated the interpretation of their results. The presentation incorporates quantitative data and qualitative interviews to elucidate the intricacies of the links already explored in preceding chapters. Furthermore, five banks out of the banks highlighted in Chapter 2 and Chapter 4 of the study, whose consumers were among the respondents, were engaged in reviewing the framework's relevance towards improving USSD technology adoption in their digital financial services strategy.

Table 7.4 summarizes each research theme's contribution level to the research objective based on their constructs and the study goals, as inferred from the conducted analyses.

Table 7.4: Level of Contribution of the Framework's Construct

Stimulus	Construct	Test Factors	Level of Contribution
Hypothesis 1	**Design**	USSD technology design will positively impact the motivation to adopt DFS	Very High
Hypothesis 2	**Security**	USSD technology security will negatively impact the motivation to adopt DFS	Very High
Hypothesis 3	**Information Quality**	USSD technology information quality will positively impact the motivation to adopt DFS	Very High
Hypothesis 4	**System Quality**	USSD technology system quality will positively impact the motivation to adopt DFS	Very High
Organism	**Construct**	**Confirmatory Test**	**Level of Contribution**
Hypothesis 5	**User Experience**	USSD technology user experience will positively impact consumers to use of DFS	High
Hypothesis 6	**Perceived Usefulness**	USSD technology's perceived usefulness will positively impact consumers to use of DFS	High

Hypothesis 7	**Perceived Risk -**	USSD technology perceived risk will negatively impact consumers to use of DFS	High
Hypothesis 8	**Perceived Trust**	USSD technology perceived trust will positively impact consumers to use DFS	High
Respond	**Construct**	**Confirmatory Test**	**Level of Contribution**
Hypothesis 9	**Intention to Use**	Consumers intention to use USSD technology for DFS will positively impact derived satisfaction	Very High
Hypothesis 10	**Satisfaction**	Organism factors will positively impact satisfaction derived by customers in using USSD technology for DFS	Very High

7.4 Chapter Summary

This chapter presents the integrated quantitative research results carried out using questionnaires and qualitative research results carried out using semi-structured interviews based on the USSD technology adoption framework and correlates their results in line with the research objectives. Integrated results suggest that all the constructs of Stimulus, Organism and Response in both quantitative and qualitative results summarise the interdependencies of factors considered for this study based on the results presented in this chapter. The chapter further justifies the results by reviewing relevant literature to justify research outcomes. Research contribution, limitations of the study, recommendations based on the study's results, and concluding remarks are presented in the following chapter.

CHAPTER 8- DIAGRAMMATIC OVERVIEW

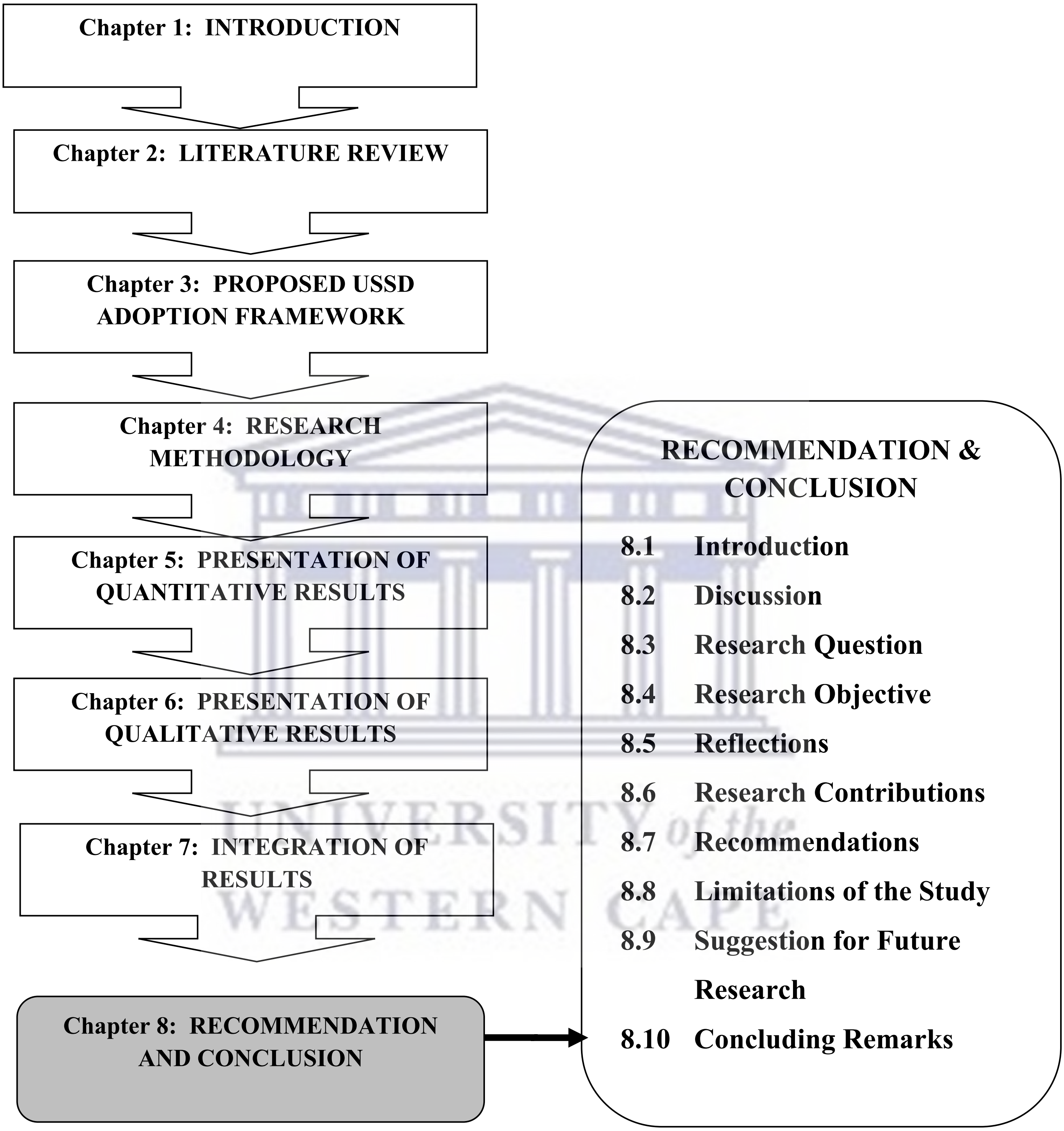

Figure 8.0: Diagrammatic Overview of Recommendations and Conclusion

CHAPTER 8 – RECOMMENDATIONS AND CONCLUSION

8.1 Introduction

As discussed in Section 2.4.1, the growing confluence of major players driving digital financial services in Nigeria (Banks, Mobile Money Operators, Payment Service Providers and Telcos) has necessitated understanding standard technology drivers to achieve national financial inclusion initiatives. To accelerate a digitally inclusive economy and expedite a higher digital financial inclusion rate in Nigeria via a cost-effective technology such as USSD technology, it is imperative to adopt a research-oriented perspective to guarantee the involvement of all relevant parties and the financially enabled people in Nigeria. Although there might be some political undertone on how various stakeholders in the digital financial services ecosystem interact, the study's objective is to provide a research-driven lens with tested outcomes that can be generalised to allow all economic actors and players in the digital financial services ecosystem to understand key drivers and enablers of digital financial inclusion as envisioned by the Central Bank of Nigeria. As the primary objective of this study, a framework for improving the adoption of Unstructured Supplementary Data Service (USSD) Technology for Digital Financial Services in Nigeria was proposed.

Four other secondary objectives were developed to empirically investigate constructs of the framework to assist regulators, academic researchers, mobile network operators, banks, and other players within the digital financial services ecosystem in understanding the impact of these constructs on deepening adoption of USSD technology to achieve CBN's digital financial inclusion target by the year 2025. To accomplish the study objective, the study argued the weakness of existing models and frameworks and used a user-centric model to propose a USSD technology adoption framework to improve digital financial services in Nigeria. This provided answers to the primary and secondary research questions based on the proposed framework for this study. The background of the study, objectives, suggested USSD technology adoption framework and layout of the study process are discussed in Chapter 1.

Chapter 2 provides a combined literature review of mobile technology evolution, the role of USSD technology, and USSD use cases in the digital financial services ecosystem. The chapter further discussed relevant theories underpinning the USSD technology adoption framework. This provides the theoretical foundation upon which the USSD technology adoption framework was developed to improve USSD technology adoption for digital financial services in Nigeria. In addition, Chapter 2 discussed some relevant theories in IS, focusing on technology innovation, technology adoption, and technology diffusion. Some of these theories are fundamental to the theories adopted for this study. The proposed framework and its constructs are discussed in Chapter 3. Chapter 4 of the study presented and discussed the research methodology employed to investigate and verify the suggested USSD technology adoption framework.

Also, in Chapter 4, we discussed the suitability and justification of the mixed methods research strategy used for the study. In addition, the data collection approach, the quantitative and qualitative analysis of the data collected, and the validation techniques used for the study were discussed in Chapter 4. Chapter 5 presents the results of the quantitative analysis and the study findings. Chapter 6 shows the results of the qualitative analysis, which was derived using semi-structured interviews. Findings of quantitative and qualitative results were presented and discussed in chapter 7 of the study. In chapter 8, the last chapter, the study describes how the objectives have been achieved. This chapter further addressed the success of the results in answering research questions for the survey, how the study was successful in achieving its goals, and from which conclusions and recommendations were drawn. The chapter also discussed how it contributed to the body of knowledge, the limits of the study, and areas that need further research investigation.

8.2 Discussion

Despite the proliferation of mobile technology and mobile-based services across Nigeria's digital financial services ecosystem, the percentage of the disconnected population accessing digitally enabled financial services and the digital economy has not significantly increased due to the unaffordability and accessibility of internet and smartphone-enabled services. As part of regulatory intervention to improve the adoption and usage rate in Nigeria, the Central Bank of Nigeria (CBN) in 2017 signed a Memorandum of Understanding (MoU) with the Nigerian Communications Commission (NCC) to officially include the mobile network operators within the digital financial services mainstream. This was followed by releasing a regulatory framework on Unstructured Supplementary Service Data (USSD) in June 2018. With the growing influence of technology on the digital financial services ecosystem in Nigeria, USSD technology has become the most important means of enabling financial transactions and digital financial inclusion, which are vital drivers of the financial inclusion strategy of the Central Bank of Nigeria.

Following the signing of the MoU between the CBN and NCC, several politically inclined discussions and debates have occurred among all stakeholders. These include customer ownership rights, USSD access charge fees, transaction pricing model, settlement of outstanding fees owned by Banks to Telcos and shared oversight responsibility between the CBN and NCC. Among all these issues, the

USSD pricing model emerged as the most impactful to end users. Banks owed the network providers from using the USSD platform, which is charged on corporate billing rather than end-user billing, as the banks preferred. In response to this, a joint communication was issued by both CBN and NCC in 2021, providing a resolution framework that is acceptable to all parties. This enables banking institutions to offer USSD technology accessibility so that clients can initiate banking transactions and other financial services. In addition, the resolution framework facilitated the adoption of a flat fee per transaction when using USSD to access digital financial services in the country.

Using Nigeria's high mobile phone penetration rate (around 80% of adults), digital technology promotes financial services to rural communities and underserved population segments. It also broadens financial service coverage by providing lower-cost alternatives (for example, mobile transfers are less expensive than conventional modes of money transfer). Finally, it promotes economic development by allowing new business models, digital infrastructure investment, and e-commerce. In a 2021 report by Enhancing Financial Innovation and Access (an organisation working on financial services deepening in Nigeria), financial exclusion in Nigeria as of December 2020 stands at 36% against a 5% target by 2025 as indicated in the Central Bank of Nigeria revised National Financial Inclusion Strategy (EFInA, 2021). With 90% of banks and non-bank players in Nigeria offering digital financial services and products leveraging USSD technology, the adoption rate is still low and might unlikely improve the financial inclusion rate to 95%, as projected.

The key indicator here is that USSD technology is yet to compensate for the enormous investments but low penetration and affordability of internet services for digital financial services within the Nigerian population despite being mentioned by the Central Bank of Nigeria as a key enabler to achieving the 95% financial inclusion rate by 2025. The overall research objective is justified in response to the discovery discussed in the paragraphs above and the ongoing national financial inclusion drive by the CBN, which has USSD technology as a significant driver for financial inclusion (CBN, 2019) and can only be achieved by providing empirically proven evidence on key indicators to improve USSD technology adoption. According to the CBN, digital exclusion in the financial services ecosystem is a growing challenge in all markets, which can inhibit social mobility and lack of knowledge or devices to access digital services. In Nigeria, deploying USSD mobile solutions has made access to electronic payments and other banking services more broadly available due to high mobile phone penetration rates and legacy technology, such as USSD, for mobile money transactions (Ferreira, 2018).

With over 150 licensed financial institutions in Nigeria providing various digital financial services (as of December 2022) using USSD technology, understanding behavioural intentions to use the technology and its consequences to determine determinants for improved adoption and customer satisfaction has become imperative. This study developed and validated a framework that would improve the adoption of USSD technology for digital financial services, focusing on the Nigerian banking industry. This is the study's significant contribution to enriching the understanding of regulators, banks, mobile network operators, and other players on improving USSD technology adoption within the digital financial services ecosystem. Limited technology adoption research streams have a mix of individual behavioural decisions and actual use and the impact of the technology's features and capabilities on the customer's motivation to use the technology. This might eventually lead to resistance to technological adoption if not rigorously analysed from a multi-disciplinary perspective.

The differentiator of this study and its main contribution to the scientific body of knowledge is the incorporation of technical design and user experience constructs integrated with three other IS theories relevant to USSD technology adoption decisions. Numerous academics have questioned the applicability of existing technology adoption frameworks and the options for deploying USSD technology. The study's findings demonstrated that building a framework to promote USSD technology adoption requires a mix of the technology's features and capabilities and the adopter's incentive to utilize that technology. This would allow for a comprehensive examination to address the complicated behavioural decisions made by technology users. There is no one-size-fits-all solution to complex problem situations of national interest; they are unsuitable for handling challenging problems associated with behavioural intentions for technology adoption decisions in a multi-ethnic and multilingual country like Nigeria.

The study's proposed USSD technology adoption framework was developed after reviewing relevant technology adoption theories and models. In developing the proposed framework, literature on previous research was extensively reviewed in Chapter 2. The strengths and weaknesses of these frameworks and models were analysed in Chapter 3 as part of the research framework development. The developed theoretical framework to improve the adoption of USSD technology for digital financial services in Nigeria was an extension of the stimulus theoretical framework and integration of two other theories: the technology adoption model (TAM) and information system success theory, as discussed in Chapter 3. The preliminary research framework was later validated using explanatory sequential mixed methods. The study's main contribution is developing and validating a framework to improve USSD technology adoption decision-making to perform digital financial services in Nigeria.

Empirical results from the survey also provided academic and practical bases for scholars and practitioners focusing on the Nigerian banking industry in their future scholarly research. The developed framework to improve USSD technology adoption will help various stakeholders and academics understand the technical and behavioural adoption determinants of USSD technology. It will help the Central Bank of Nigeria and the Nigeria Communication Commission set policies to meet realistic intermediate inclusion targets, especially in using specific financial products. They should address operational, security, capacity, and regulatory measures more explicitly to motivate customers toward adoption. USSD technology provisioning for digital financial services in Nigeria has two major players (banks and MNOs) and regulators (CBN – banking regulation and NCC-telecommunication / MNO regulation). The overlapping jurisdiction and differences in the basis for assessment and process mean that coordination among the different regulators is critical.

The study on mobile financial services (MFS) is experiencing growth due to the growing use and popularity of smartphones and the rising demand for mobile banking and payment services. This research focuses on several viewpoints, including the consumer, management, policy, and theoretical aspects of MFS (Shaikh et al., 2023). The Nigeria Communication Commission -the telecommunications regulator in Nigeria is typically best placed to lead interventions on USSD-enabled capabilities for digital financial services. With USSD as an "essential facility" and MNOs being licensed as payment service banks and regulated by the CBN, it is essential to maintain or enhance competition in the market or prevent a situation where anti-competitive behaviour is likely, primarily where banks rely on MNOs to provide a competing business proposition for digital financial services. By contrast, competition authorities must pass a higher hurdle to intervene, typically needing to meet a strict definition of anti-competitive behaviour or an "abuse of dominant position" that could lead to competition, high cost, and consumer dissatisfaction.

The study acknowledges that for customers serviced by multi-stakeholders, with different regulators overseeing their operations for complimentary services like USSD technology, a multi-stakeholder engagement strategy is required, as suggested by the study. In addition, the study concedes that to improve USSD technology adoption, underlying adoption determinants need to be contextualised and evaluated from different sociological paradigms to understand behavioural intentions, technical capabilities, and human-centred thinking principles. In realising the research objectives, the study provides an empirical analysis of the impact of features and capabilities of USSD technology on the motivation of consumers to use USSD technology to perform digital financial services. The study results further indicate that out of the stimulus properties of the framework, which are features and capabilities of USSD technology such as design, security, information quality, and system quality, security and system quality challenges have the most significant impact on behavioural intentions to adopt USSD technology for digital financial services.

For the organism properties of the framework, which are motivating factors for the adoption of USSD technology for financial services such as perceived risk, perceived ease of use, perceived usefulness, and perceived trust, study results show that perceived risk and perceived usefulness have the most significant impact on customer's decision to adopt USSD technology for digital financial services. By involving subject matter experts from the telecommunication, banking, and payments services sectors with different worldviews on the USSD technology adoption decision process, the study's outcome would enable banks and mobile network operators to understand drivers towards improved USSD technology adoption and reshape their policy formulation, investment decisions, and strategic and tactical interventions towards improving USSD technology-based services in Nigeria's digital financial services ecosystem.

Furthermore, the study's outcome can be used by the CBN, NCC, banks, MNOs, and other industry players to examine the influence of USSD technology adoption for digital financial services, and recommendations of this research can enable relevant stakeholders to execute strategies in the realisation of the 95% financial inclusion targets by 2025. In the next part, we will discuss how the study has answered the research questions.

8.3 Research Question – To what extent were the research questions answered?

Significant discussions and findings from the research are to answer the main research question and the four secondary research questions. To understand the extent to which the study answered the main research question, the four secondary research questions would be validated, followed by the main research question in that sequence. This section, therefore, discusses how the study answered secondary research questions before answering the main research question.

The first secondary research question:

- **What are the current challenges of Unstructured Supplementary Data Service (USSD) technology adoption for digital financial services in Nigeria?**

Chapter 2 of the study discussed technical, business, and regulatory-related challenges. These are important to understand perspectives of how USSD technology adoption challenges can be analysed and resolved from individual and organisational levels. These also provided an understanding of the preliminary framework developed to improve USSD technology adoption for digital financial services in Nigeria.

The second secondary research question:

- **How can the current challenges in using USSD technology for digital financial services in Nigeria be addressed?**

To address a challenge, it is vital to understand the problem's fundamentals and devise an appropriate methodological approach for resolution. Chapter 2 of the study holistically discussed Nigeria's digital financial services ecosystem and various use cases of USSD technology adoption for digital financial services. Also, chapter 2 provided the background of current challenges from different worldviews. The review of multiple theories and frameworks in Chapter 2 also contributed to understanding some of the shortcomings of existing models and frameworks inhibiting the USSD technology adoption decision-making process at an individual level. Chapter 2, the literature review chapter, noted that numerous scholars have questioned the applicability of existing technology adoption frameworks. Also, whether choices on deploying a widespread technology such as USSD are made in the best interests of service providers, customers, or both without considering the impact of the technology's features and capabilities on the customer's purpose and incentive to utilize the system, this could ultimately lead to technology adoption resistance if not carefully examined as justified in chapters 5, 6 and 7 of the study.

From a theoretical standpoint, as discussed in Chapter 3, technology adoption challenges that necessitate a combination of the technology's features and capabilities, as well as the adopter's motivation to use that technology, are too complex to be solved with a single approach as there is no one-size-fits-all solution to problem situations. This informs the USSD technology adoption framework developed for the study with the results of the findings discussed in Chapters 5, 6, and 7.

The third secondary research question:

- **(a) How will the stimulus factors (features and capabilities of the USSD technology) affect the adoption and use of USSD technology for digital financial services in Nigeria?**

- **(b) How will the organism factors (motivating factors for using USSD technology) affect the adoption and use of USSD technology for digital financial services in Nigeria?**

To answer the third secondary research question (a and b), the stimulus theory was extended by integrating TAM and IS success theory constructs to develop a framework in Chapter 3 to improve USSD technology adoption for digital financial services in Nigeria. This informed the basis for data collection and analysis, as discussed in chapters 4 -7. The results indicate that stimulus and organism factors complement each other, as indicated by integrated results discussed in Chapter 7. The study shows that all the stimulus and organism factors significantly predict USSD technology adoption and usage. However, the results show that security and risk, system quality, and transaction cost are significant barriers to consumers' intention to adopt USSD technology for digital financial services.

The fourth secondary research question:

- **What would be a framework to improve USSD technology adoption for Digital Financial Services within the Nigerian Banking Industry?**

To understand the determinants that improve USSD technology adoption, a hypothesis needs to be drawn from the research for further investigation. The study identified relevant factors from three IS theories and proposed a USSD technology adoption framework. The USSD technology adoption framework was empirically investigated using quantitative and qualitative analysis. Both analyses were triangulated, and three themes were identified as significant barriers to improving the adoption of USSD technology for digital financial services. Chapters 5 and 6 expressed risk, security, system quality, and cost concerns. Chapter 7 presents recommendations and strategies around these three main themes.,. These recommendations and suggested strategies would assist in technology investment decisions, policy formulation, and strategy execution by regulators, banks, and MNOs.

The main research question:

- **How will Unstructured Supplementary Data Service (USSD) Technology adoption for Digital Financial Services be improved within the Nigerian banking industry?**

Developing a framework to improve USSD technology adoption for digital financial services in Nigeria, with a population of over 200 million with 80% mobile-enabled adults, requires understanding the features and capabilities to deliver USSD-based services by banks and MNOs and understanding behavioural and cognitive aspects of intended users that will adopt USSD technology for various digital financial services. This study used a multi-disciplinary approach underlined with different research paradigms to determine multiple factors that would leapfrog Nigeria to the next level of digital financial inclusion, leveraging USSD technology, as detailed in Chapters 2, 4, 5, 6, and 7. The following section addresses to what extent the study met its aims and objectives.

8.4 To what extent did the study achieve research objectives?

The primary objective of this study is to propose a USSD technology adoption framework to improve Digital Financial Services in Nigeria. Chapter 1 lays the background for the research, including research objectives and questions to be answered. This was followed by an extensive literature review of relevant studies on mobile technology innovations, USSD technology use cases, and technology adoption theories in Chapter 2. A USSD technology adoption framework was proposed in Chapter 3 of the study, discussing the constructs. Constructs of the proposed framework were investigated and validated using explanatory sequential mixed methods research. Results from quantitative and qualitative analysis were presented in Chapters 5, 6, and 7 of this study to validate the USSD technology adoption framework.

The secondary objectives:

- **To investigate the current challenges of Unstructured Supplementary Data Service (USSD) technology adoption for digital financial services in Nigeria**

The study met this objective by discussing technical, business, and regulatory-related challenges through an extensive literature review in Chapter 2. The literature review helped identify current gaps in USSD technology and reviewed the strengths and weaknesses of existing models and frameworks. Based on the constructs of the proposed research framework, data were collected through questionnaires about customers' viewpoints on using USSD technology to perform digital financial services. These data were validated and analysed through a quantitative research technique. Qualitative results were derived by interviewing subject matter experts to validate quantitative results, as discussed in Chapters 6 and 7.

- **To investigate how the current challenges in the use of USSD technology for digital financial services in Nigeria can be addressed**

This study met this objective by understanding the challenges of adopting USSD technology for digital financial services in Nigeria through an extensive literature review. The study further reviewed various theories and frameworks in Chapter 2, which contributed to understanding some of the shortcomings of current models and frameworks inhibiting the USSD technology adoption decision-making process at an individual level. The outcome of this investigation and recommendations to address these challenges were discussed in Chapter 7.

- **(a) To determine the impact of the stimulus factors (features and capabilities of the USSD technology) on the adoption and use of USSD technology for digital financial services in Nigeria**
- **(b) To determine the impact of organism factors (motivating factors for using USSD technology) on the adoption and use of USSD technology for digital financial services in Nigeria**

The study met the objectives (a and b) by quantitatively and qualitatively analysing the data collected, as discussed in Chapter 4. While the quantitative results helped to answer the "what" questions of validation, the qualitative results enabled the answer to the "why" questions while verifying the developed framework. Based on Chapters 5, 6 and 7 results, the study indicates that all the stimulus and organism factors are significant predictors of USSD technology adoption and usage with security and risk, system, quality and transaction cost. These were the considerable barriers to consumers' intention to adopt USSD technology for digital financial services.

- **To provide recommendations and improvement strategies for the adoption and usage of USSD technology for digital financial services in Nigeria**

The study met the objective by providing recommendations to improve USSD technology adoption for digital financial services, as discussed in Chapter 7.

- **To propose a framework to improve Unstructured Supplementary Data Service (USSD) Technology adoption for Digital Financial Services in the Nigerian banking industry**

The study met the objective by extending stimulus theory using constructs of TAM and IS success theory to propose an integrated framework in Chapter 3, based on the extensive literature review from Chapter 2.

The following section discusses reflections on the study regarding the challenges encountered.

8.5 Reflections

Developing quality research outcomes requires time and dedication from the researcher. Some of the challenges encountered were delays in respondents providing feedback due to their perceived understanding that the exercise may require sensitive financial information, which was not the case. Lack of physical interaction during the COVID-19 pandemic was also a limitation for the timely completion of the questionnaire. Similarly, qualitative research interviewers insisted on getting requisite approvals from their various employers before participating in the interview process. Respondents felt their voices could reach relevant authorities, banks, and MNOs through the outcome of this study. Therefore, an upfront authorisation by their employers is required. The following section discusses the study's contribution to the body of knowledge.

8.6 Research Contribution

Research in information systems offers an interdisciplinary approach to understanding a phenomenon from a multi-disciplinary standpoint. The study's main contribution is developing and validating a USSD technology adoption framework to improve USSD technology adoption decision-making to perform digital financial services in Nigeria. The study comprehensively reviewed existing literature on technology innovation and created an extended theoretical framework by integrating constructs of TAM, IS success, and stimulus theories to investigate adoption factors based on features, capabilities, and usage intentions of USSD technology to perform digital financial services among Nigerians. As a motivator for adoption and use, the research framework replaced perceived ease of use with User Experience in previous TAM research. Trust and System Quality and Design and Security were represented as stimuli for the adoption and use of USSD technology for Digital Financial Services. The USSD technology adoption framework's constructs for this study were hypothesised using a mixed-method research strategy.

8.6.1 Contribution to the Body of Knowledge

The formation of the research gap, which serves as the foundation for investigating any issue, phenomenon, or scientific topic, is responsible for most research in any field (Miles, 2017). As discussed in Chapter 1, the crux of the study is to use an interdisciplinary approach to develop a USSD technology adoption framework as identified from a research gap and investigate the constructs to improve its adoption to perform digital financial services. The identified research gap is aligned with Miles's taxonomy of research gaps (2017). Miles (2017) proposed a taxonomy of research gaps built on the two previous models. It consists of seven core research gaps: (a) Evidence Gap, (b) Knowledge Gap, (c) Practical-Knowledge Conflict Gap, (d) Methodological Gap, (e) Empirical Gap, (f) Theoretical Gap, (g) Population Gap. This is summarised in Table 8.1.

Table 8.1 Research Gap Types

S/N	Research Gap Type	Description
1	Evidence Gap (Contradictory Evidence Gap)	Results from studies allow for conclusions in their own right but are contradictory when examined from a more abstract point of view.
2	Knowledge Gap (Knowledge Void Gap)	Desired research findings do not exist
3	Practical-Knowledge Gap (Action-Knowledge Conflict Gap)	Professional behaviour or practices deviate from research findings or are not covered by the research
4	Methodological Gap (Method and Research Design Gap)	A variation of research methods is necessary to generate new insights or to avoid distorted findings
5	Empirical Gap (Evaluation Void Gap)	Research findings or propositions need to be evaluated or empirically verified.
6	Theoretical Gap (Theory Application Void Gap) Theory	Theory should be applied to certain research issues to generate new insights. There is a lack of theory; thus, a gap exists [Müller-Bloch

7	Population Gap	Research regarding the population that is not adequately represented or under-researched in the evidence base or prior research (e.g., gender, race/ethnicity, age, etc).

Source: Identifying and Defining the Seven Research Gaps (Miles, 2017)

This study aims to address methodological and theoretical gaps. The differentiator of this study and its main contribution to the scientific body of knowledge is the incorporation of technical design and user experience constructs integrated with three other IS theories relevant to USSD technology adoption decisions. Numerous academics have questioned the applicability of existing technology adoption frameworks and the options for deploying USSD technology. The study's findings demonstrated that building a framework to promote USSD technology adoption requires a mix of the technology's features and capabilities and the adopter's incentive to utilize that technology. This would allow for a comprehensive examination to address the complicated behavioural decisions made by technology users. There is no one-size-fits-all solution to complex problem situations of national interest; they are unsuitable for handling challenging problems associated with behavioural intentions for technology adoption decisions in a multi-ethnic and multilingual country like Nigeria.

The study generally contributes to the current IS body of knowledge, focusing on adopting low-cost (USSD) technology to drive digital financial inclusion. The USSD technology adoption framework proposed and investigated in the study provided a baseline to expanding constructs of existing theories of technology adoption and integrating two models to develop a USSD technology adoption framework that can be used for future academic research. The study's contribution cannot be overstated due to unprecedented changes in technological innovation and dynamic behavioural intentions to adopt that technology. With the framework used in this study, the study helped address the research gap in the body of knowledge by understanding how the features and capabilities of USSD technology would motivate individuals in Nigeria to adopt and use USSD technology for digital financial services. Also, the study made contributions through publications in two peer-reviewed journals.

8.6.2 Contribution to Industry Practice

From a practical standpoint, information technology diffusion literature has indicated that USSD technology, which is part of the 4IR, has the potential to threaten bank business models in the wake of fintechs capable of disrupting the digital financial service ecosystem with emerging technologies. With this development, banks and new entrants into the digital financial service ecosystem have resulted in USSD technology, which is the most prevalent, to provide essential financial services such as lending, person-to-person payment, and airtime top-ups that are cost-effective and efficient. The outcome of the study can be used by regulators, banks, mobile network operators, and other industry players to examine the influence of USSD technology adoption for digital financial services, and recommendations of this research can enable relevant stakeholders to execute tactical and strategic interventions in the realisation of improved USSD technology adoption and the 95% financial inclusion targets by 2025.

The USSD technology adoption framework for the study is client-centric and can be adopted by any country with high mobile phone penetration and low smartphone or internet penetration. Recommendations discussed in this study are agnostic for further research interest in a country with the same political will to have an MoU between two regulators or willingness to have a single regulator oversee mobile network operations and provision digital financial services relying on USSD technology. The following section presents some recommendations based on the results of the study. The following section offers some recommendations that can be inferred.

8.7 Recommendations

The following recommendations have been made based on the results of this study.

i. The study recommends engaging the correct population mix, including the bottom of the pyramid population, technocrats from the banking and telecommunication sectors, and relevant stakeholders to understand what could motivate various population classes to adopt and use USSD technology to perform digital financial services. In realising the CBN's payments system strategy, the study also recommends adopting a no-one-size-fits-all approach to have collective views of various factors that could inhibit digital inclusivity and USSD technology adoption within the digital financial services ecosystem.

ii. The study recommends decreasing the MNO-bank charges for USSD session time. The session time cost charged by MNOs to banks is added to the overall transaction cost charged to last-mile consumers. This could be achieved through continued mediation by the Central Bank of Nigeria and the Nigerian Communication Commissions (NCC). The reduction will positively improve the tendency of the bottom of the pyramid and underserved populations to consider adopting USSD technology as an alternative solution and preference for cash to perform various digital banking services in the country.

iii. The study recommends that regulators institutionalise an investment decentralisation policy to achieve an equilibrium quality state for USSD technology services. Due to low business growth opportunities in rural and low-income areas in Nigeria, banks and MNOs have fewer infrastructural investment considerations in these areas, including telecommunication base stations. This has led to poor quality of service delivery with repeated procedures to initialise transactions at an additional cost to the consumer. If not considered, this could lead to losing customer trust and possible resistance to using USSD technology to access digital financial services.

iv. The study recommends reducing competition intensity between MNOs and Banks through consistent dialogue and establishing a rapid dispute resolution mechanism to uphold customer trust in the system. The CBN should strengthen Consumer Protection programmes based on issued standards to ensure a timely and comprehensive dispute resolution.

v. The study also recommends the adoption of a coopetition (collaboration while competing) framework in the payment system strategy as part of the open banking regulation among stakeholders with agreed service levels. This is due to the need for interoperability and interdependency of various systems and applications between Banks and MNOs and the sharing of sensitive data. To encourage such an outcome, regulators could attempt a light-touch moral suasion approach (together with reasoning for this preference).

vi. The study recommends continuous review of various security and fraud mitigation frameworks inherent in using USSD technology for digital financial services. This includes the push ahead with refining the existing framework and implementation strategies to combat SIM Swap and other fraud-related issues. The study also recommends activating the Bank Verification Number (BVN) and National Identification Number (NIN) capability in the CBN payment system vision document to combat fraud-related cases. In developed countries, the end-to-end encryption (E2EE) concept for USSD technology data transmission has been adopted for financial services because they are more secure and dynamic in application-driven environments. This study suggests reviewing the current USSD technology security design and proposes E2EE for USSD deployments for financial services.

vii. The study also suggests a robust framework and policies on PIN management and authorisation mechanisms with a continuous review of advanced encryption technology to enable non-compromise of customer personal identification numbers (PIN), including behavioural pattern detection. To enhance the security of certain thresholds of transactions, the adoption of

International Mobile Equipment Identity (IMEI) and International Mobile Subscriber Identity (IMSI) is suggested.

viii. The study recommends continuous investments in support of running media campaigns to improve the awareness and understanding of USSD technology capability among users. This would improve usability awareness and sensitisation on fraud mitigation actions.

ix. The study recommends the adoption of human-centred design thinking principles in the design and development of future USSD-based applications from a user-centric approach that could be used to facilitate digital financial services. The study further suggests the introduction of multilingual features in Nigeria's three major languages (Yoruba, Hausa, and Igbo)

In addition to the above recommendations, the study's outcome is essential for banks, MNOs, and the two regulators (CBN and NCC) to understand the pain points of bank customers and areas where policy, standards, and technology interventions can be applied to achieve digital financial inclusion targets. This is another important recommendation for the improved USSD technology adoption framework developed for the study. The following section discusses the limitations of this study.

8.8 Limitations of the Study

For every study, there is a limitation that forms the basis and provides the opportunity for future research. Although the study contributed to understanding factors that would improve USSD technology adoption for digital financial services in Nigeria, the research outcome might not be generalised to another country with a different operating environment and governance model. Due to subjectivity based on feelings and orientation, which is associated with survey completion on behavioural intentions to adopt technology, some respondents might have some bias in the completion of the survey. However, the framework can be improved with other technology adoption theory constructs to correlate deviations in future research outcomes. Despite these limitations, using a mixed methods research strategy enriched the study's outcome by applying multiple qualitative and quantitative analysis lenses. The following section discusses opportunities for future research in USSD technology adoption decisions to perform digital financial services.

8.9 Suggestions for Future Research

Based on the theories underpinning the study, including factors that will improve USSD technology adoption decisions to perform digital financial services in Nigeria, other technology adoption theories can be considered and empirically tested using a survey method to validate the study's outcome. This is a possibility for future research that can be explored. For the generalisability of the study to a large population or targeted population, country-specific or situation-specific factors can also be substituted in the constructs of the research framework and investigated using a simple survey method. These would provide comparative analysis and evidence in deviations of results targeted at improving USSD technology adoption in the digital financial services ecosystem. Advancements in technology changes are dynamic; likewise, regulatory and market-driven factors are essential in adopting USSD technology.

As Mobile Network Operators, Banks, and Telcos continue to improve on USSD technology services to drive its wider adoption to perform digital financial services, quantitative and qualitative outcomes of this study can be used to evaluate their internal business operations and can guide senior managers in strategic decision-making for improvement. However, this would require extrapolating decision outcomes with other research models that can be used to measure the influence of external factors. As political, customer needs, legal implications, and economic factors remain dynamic towards USSD technology adoption, and the study recommends future research using a PESTLE model or any similar socio-economic inclined research model that can be explored for similar academic research with consideration for regulatory, economic, social, technological, legal and environmental perspectives. Unlike in Nigeria, this can also be tailored to an applicable regulatory provision where co-regulation for USSD technology-based digital financial services might not be required.

Hence, a future researcher focusing on this phenomenon needs to understand the current market, regulatory, and technological trends at the time for the appropriate application of the results of this study. With this in mind, the researcher suggests using a longitudinal study design to measure the USSD technology adoption rate over time due to these changes. In addition, more advanced data collection and statistical analysis techniques with higher can be employed. A longitudinal study design can be explored for future research. This would measure the extent of change in a USSD technology adoption over a period. As a result, this study opens up various possibilities for future research on USSD technology adoption decisions to perform digital financial services.

8.10 Concluding Remarks

The study's main contribution is developing and validating a framework to improve USSD technology adoption decision-making to perform digital financial services in Nigeria. The study's empirical results helped provide academic and practical bases for scholars and practitioners focusing on the Nigerian banking industry in their future academic research. CBN plans to make Nigeria a centre of excellence in USSD and lead deployments in other markets with similar demographics and mobile profiles by working with the Nigerian Communication Commission (NCC) to further make USSD technology attractive. The study's outcome can be used by regulators, banks, mobile network operators, and other industry players to achieve this strategic vision by critically examining influencing factors from practitioner and academic research lenses. Finally, the recommendations of this study would enable relevant stakeholders to execute tactical and strategic interventions in the realisation of improved USSD technology adoption and over 95% digital financial inclusion targets.

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APPENDICES

Appendix I: Quantitative Questionnaire

SECTION A

PERSONAL DATA

Instruction: Tick the appropriate box in the options as it applied to you.

1. Location: …………………………………………………………

2. Gender (a) Male ☐ (b) Female ☐

3. Age (a) 22 – 35 years ☐ (b)36 – 55 years ☐ (c) 55 years & above ☐

4. Occupation (a) Worker ☐ (b) Business Owner ☐ (c) Student ☐

6. Specify Bank/Service Provider: ____________________________________

7. Level of use of Mobile Technology (a) High ☐ (b) Medium ☐

(C) Low ☐ (d) None ☐

8. Duration in using USSD for Digital Financial Services: (a) Less than 6 months ☐

(b) 6 months but less than 1 year ☐ (C) More than 1 year ☐

SECTION B

QUESTIONNAIRE ITEMS

Instruction: Please indicate your responses by ticking the right box or filling in as appropriate best.

Key Weight

Strongly Agree = 5
Agree =4
Undecided =3
Disagree =2
Strongly disagree =1

A. **Technical design**: includes interactiveness of the USSD solution, clarity and simplicity in using it to perform digital financial services

S/N	Item Statement	S A	A	U D	D	S D
9	Technical design significantly affects User experience when using USSD for digital financial services					
10	Technical design significantly affects Perceived Usefulness of USSD for digital financial services					
11	Technical design significantly affects Perceived Risk in using USSD for digital financial services					
12	Technical design significantly affects Perceived Trust in the use of USSD for digital financial services					

B. **Security :** is the reliability, safety, and privacy in using USSD technology to perform digital financial services

S/N	Item Statement	S A	A	U D	D	S D
13	Security factor significantly affects User experience in the use of USSD digital financial services					
14	Security factor significantly affects Perceived Usefulness in the use of USSD for digital financial services					
15	Security factor significantly affects Perceived Risk in the use of USSD for digital financial services					
16	Security factor significantly affects Perceived Trust in the use of USSD for digital financial services					

C. **System quality:** is a measure of the performance of USSD technology for digital financial services measured in terms of functionality, reliability, data quality, flexibility, system accuracy and capability

S/N	Item Statement	S A	A	U D	D	S D
17	System quality significantly affects User experience in the use of USSD for digital financial services					
18	System quality significantly affects Perceived Usefulness in use of USSD for digital financial services					
19	System quality significantly affects Perceived Risk in the use of USSD for digital financial services					
20	System quality significantly affects Perceived Trust in the use of USSD for digital financial services					

D. **Information quality:** is a measure of improved authentication and efficient processing

S/N	Item Statement	S A	A	U D	D	S D
21	Information quality significantly affects User experience in the use of USSD for digital financial services					
22	Information quality significantly affects Perceived Usefulness in the use of USSD for digital financial services					
23	Information quality significantly affects Perceived Risk in the use of USSD for digital financial services					
24	Information quality significantly affects Perceived Trust in the use of USSD for digital financial services					

E. **User Experience (UX):** is the perception, feelings, motivations, and values as a result of using USSD technology for digital financial services

S/N	Item Statement	S A	A	U D	D	S D
25	User experience significantly contributes to consumer's intention to use USSD technology for digital financial services					
26	User experience significantly contributes to user satisfaction in using USSD technology for digital financial services					

F. **Perceived Usefulness**: is the extent to which an individual believes that using USSD technology will enhance their tasks and continuous usage in performing financial services

S/N	Item Statement	S A	A	U D	D	S D
27	Perceived usefulness significantly contributes to consumer's intention to use USSD technology for digital financial services					

28	Perceived usefulness significantly contributes to user satisfaction in using USSD technology for digital financial services					

G. **Perceived Risk**: is the tolerance of risk, anxiety, concern, discomfort and uncertainty during the use of USSD technology for digital financial services

S/N	Item Statement	S A	A	U D	D	S D
29	Perceived risk significantly contributes to consumer's intention to use USSD technology for digital financial services					
30	Perceived risk significantly contributes to user satisfaction in using USSD technology for digital financial services					

H. **Perceived Trust**: is the trust in the service provider to prevent authorized access to their account and financial transaction details when using USSD technology

S/N	Item Statement	S A	A	U D	D	S D
31	Perceived trust significantly contributes to consumer's intention to use USSD technology for digital financial services					
32	Perceived trust significantly contributes to user satisfaction in using USSD technology for digital financial services					

I. **Consumer's Intention on Usage**

S/N	Item Statement	S A	A	U D	D	S D
33	Use of USSD technology for digital financial services significantly leads to user satisfaction					

Appendix II: Semi-Structured Interview

Key Research Objectives

The primary objectives of the research:

- Investigate the factors, capabilities & features that will influence the adoption & usage intentions of USSD tech for digital financial services in Nigeria
- Propose a framework to improve Unstructured Supplementary Data Service (USSD) Technology adoption for Digital Financial Services (DFS) in the Nigerian banking industry.

SEMI-STRUCTURED INTERVIEW DIMENSIONS

S/N	Constructs in the Research Framework	Dimensions
1	**Technical design**: includes interactiveness of the USSD solution, clarity and simplicity in using it to perform digital financial services	To what extent has USSD technology contributed to bank consumer's choice from complex banking platforms to USSD based digital financial services?
		Has USSD technology design and implementation (non-usage of internet connectivity) contributed to its adoption and usage for digital financial services in Nigeria?
2	**Security :** is the reliability, safety, and privacy in using USSD technology to perform digital financial services	Has USSD technology implementation for digital financial services impacted bank customer's perception for scam and fraud?
3	**System quality:** is a measure of the performance of USSD technology for digital financial services measured in terms of functionality, reliability, data quality, flexibility, system accuracy and capability	Has poor telecommunication network in some part of the country contributed to low adoption and usage of USSD technology for digital financial services?
4	**Information quality:** is a measure of improved authentication and efficient processing	Has USSD technology authentication and verification method impacted consumer's intention for adoption and usage for digital financial services?
		Is USSD technology processing capability sufficient to increase country wide adoption and usage for digital financial services?
5	**User Experience (UX):** is the perception, feelings, motivations, and values as a result of using USSD technology for digital financial services	Will a friendly user interface improve consumer's intention to use USSD technology for digital financial services?
		Has USSD technology first time activation to perform digital financial services contributed to intention to use?
6	**Perceived Usefulness**: is the extent to which an individual believes that using USSD technology will enhance their tasks and continuous usage in performing financial services	Has the simplicity of USSD technology based services impacted customer's frequency of usage for digital financial services such as mobile top-up and money transfer?
7		

	Perceived Risk: is the tolerance of risk, anxiety, concern, discomfort and uncertainty during the use of USSD technology for digital financial services	Has the adoption and usage of USSD technology created consumer anxiety to perform digital financial services?
		Has USSD technology contributed to consumer's perceived risk for its adoption and usage for digital financial services?
8	**Perceived Trust**: is the trust in the service provider to prevent authorized access to their account and financial transaction details when using USSD technology	Can consumers trust USSD technology platform provided by their bank to perform digital financial services?
		Has transaction cost (charges) impacted consumer intention to use USSD technology to perform digital financial services?
		Has USSD technology quality of services by service providers (bank and telcos) significantly contributed to user adoption of USSD technology to perform digital financial services?

Moderator, note the flow of Discussion:

A. Welcome, consent process, and introduction (5 minutes)

B. Background of the study: Challenges of USSD technology adoption for DFS in Nigeria (15 minutes)

C. How to address the challenges caused by the usage of USSD technology. (20 minutes)

Impact of the stimulus and organism factors on use and adoption of USSD technology (20 minutes)

Section A: Welcome, consent process, and introduction

a. <u>**Welcome**</u>

- Good morning/afternoon/evening. I appreciate your acceptance to join this discussion to qualitatively understand factors identified (form a previous quantitative study) to improve USSD technology adoption for digital financial services in Nigeria
- The research intends to seek opinions from senior bank officials and industry experts on how adoption and usage of Unstructured Supplementary Data Service (USSD) to perform digital financial services in Nigeria can be improved.
- Constructs of the interview questions were adapted from a research framework proposed for the study. They were adapted by integrating 3 theories (the Technology Adoption Model, Information System Success Theory and Stimuli theoretical Framework). We already carried out quantitative research on bank customers to evaluate the impact of various research constructs and adoption and usage of USSD technology for digital financial services in Nigeria and that is the basis of this qualitative research work.

<u>**b. Consent Process**</u>

- Before we start, please confirm you understand the participant consent earlier shared with and you endorse that your participation is voluntary.

<u>**c. Basic Interview Guidelines**</u>

- **Probing:** We need to hear your ideas and opinions during the interview clearly and audibly. The moderator may **ask you multiple times for the reason, why?**
- There are **no right or wrong answers** to questions.
- **Audio-recording:** The discussion will be transcribed for purpose of validating the data accuracy, correctness and completeness before producing the research findings. We crave your indulgence to allow us to audio-record the session.

- **Confidentiality:** We guarantee anonymity of this interview session. At no point would your identity, e.g., name/s, etc. be revealed or referred in the process of reporting the findings of this session.

d. Interviewee self-introduction

Interviewee to briefly introduce himself / herself (name, Workplace / business place and title)

Ice breaker

(Interveiwer)

Digital financial services (DFS) are the array of basic and retail financial services, including money transfer, bill payments, mobile top-up, account balances check-up, account statement request, and more recently BVN look-up and NIN look-up across the banking industry. Unstructured Supplementary Data Service (USSD) technology has been the most usable channel to perform these services due to perverseness of mobile phones in Nigeria.

- How can you describe the evolution, adoption and usage of USSD technology in the Nigerian banking industry?
  In the past 5 years, USSD technology has been in widespread use to perform DFS contributing over 50% of retail payments in the Nigerian banking industry. What have been the determinants to have achieved this milestone across the banking industry?

Section B: To investigate the current challenges of USSD technology adoption for digital financial services in Nigeria

- What are the major complaints that you are aware of on the usage of USSD technology for digital financial services (DFS) in the Nigerian banking industry?

Probe for all possible challenges to adopting USSD technology & ask WHY do you think so?

- **Are there internal** challenges within the banking ecosystem?
  - What are they?
  - Any **external factor(s)** that frustrate the progress of the USSD technology? **If so, ask how?**

- **Are there external** challenges outside the banking ecosystem?
  - What are they?
  - Any **external factor(s)** that frustrate the progress of the USSD technology? **If so, ask how?**
- Moderator to proceed and refer **to semi-structured document (brief introduction of the interpretation of each of the constructs as it relates to this research should be given)**

Technical design: describes the interactiveness of the USSD solution, clarity and simplicity in to perform digital financial services

a) To what extent has USSD technology contributed to bank consumer's choice from the available alternative banking channels used to perform digital financial services?
b) Do you think the technical design of the USSD Platform is contributing to its adoption and usage for digital financial services in Nigeria? In what way?
c) What are the design features and capabilities to enable ease of use among core illiterate groups?

Security: describes the reliability, safety, and privacy in using USSD technology to perform digital financial services

a) What are your observations regarding the security of USSD technology?
b) Do you think use of USSD technology for DFS is safe from scam and fraud? Why?
c) As a subject matter expert, what should be done or improved upon to safeguard bank consumers against fraud including increasing their confidence about the safety and reliability of the technology?
d) How can the authentication process be enhanced to mitigate against fraud?
e) Is the level of sensitization to consumers sufficient to reduce issues of scam and fraud?
f) With an increase in fraudulent activities in spite the advent of the BVN and other security measures by telecom service providers, as an industry expert, what steps are being taken by banks to ensure optimum security using the USSD technology? **Probe fully**.
g) Are there regulatory (CBN, NCC) interventions to address these challenges? **Probe fully**

System quality: describes USSD technology performance in terms of functionality, reliability, data quality, flexibility, system accuracy and capability for digital financial services

a) Poor telecommunication networks seem to be a factor limiting usage and adoption of USSD technology in some parts of the country. Do you support this limitation and what can be done to inhibit this factor?
b) In terms of information quality and perceived ease of use, can USSD technology be used for DFS in other languages?
c) Do you think USSD outperforms internet banking in terms of functionality, system accuracy and overall quality? why?

Information quality: is a measure of improved authentication and efficient processing
a) Has authentication and verification information when using USSD technology for digital financial services impacted consumer's intention for its country-wide adoption and usage? In what way?
b) Does the USSD Technology session-time and procedures to perform DFS efficient? if yes, why? if no, what can be added to enhance the procedures?

User Experience (UX): is the perception, feelings, motivations, and values as a result of using USSD technology for digital financial services

a) Will a friendly user interface improve consumer's intention to use USSD technology?
b) Has USSD technology first-time activation to perform digital financial services contributed to its adoption for DFS use?
c) Does the current transaction charge / cost for USSD based financial services motivates consumers for repeated usage? Why?
d) Is the support given by bank's customer care / service team sufficient to promptly resolve customer complaints on USSD based financial services?

Perceived Usefulness: is the extent of consumer believe to use USSD technology to performing digital financial services

a) Is USSD implementation fit to perform- digital financial services? Why?
b) How has the adoption of USSD technology helped to improve retail payment services in Nigeria?

Perceived Risk: is the tolerance of risk, anxiety, concern, discomfort and uncertainty during the use of USSD technology for digital financial services

a) Has USSD technology contributed to consumer's perceived risk for its adoption and usage for digital financial services?
b) Can you share your opinion on steps taken by banks to reduce the discomfort of customers towards the usage and adoption of USSD?

Perceived Trust: is the trust in the service provider to prevent authorized access to their account and financial transaction details when using USSD technology

a) Can consumers trust USSD technology platform provided by their bank to perform digital financial services? If so, why?
b) Considering that the trust for one's bank is a factor in using the USSD technology, what are banks doing to improve the perceived trust of their customers for USSD based banking services?
c) Has USSD technology quality of services by service providers (bank and telcos) significantly contributed to user adoption of USSD technology to perform digital financial services?

Section C: To investigate how the current challenges in the use of USSD technology for digital financial services in Nigeria can be addressed

- Having mentioned the challenges in the adoption of the USSD technology, what efforts can be suggested to improve upon the / these challenges?
- **What** steps are being taken to ensure optimum adoption/use of the technology? **Probe fully using challenges mentioned as reference**

<u>Wrap up</u>

- **Recently in 2021, that have been issues between mobile network operators and banks on tariffs or charges for USSD sessions when performing digital financial**

services. This resulted into the suspension of USSD services. How can this issue be further addressed using your expert opinion?

- **Recap major highlights of the discussion**

- **Ask if there is/are any other thoughts besides the recap of the discussion.**

End discussion and thank the respondent a second time

Thank you for taking the time to participate in the interview. We are optimistic that the insights you shared will help the research and technical team understand the measures that can be adopted to improve USSD technology use. Once again, thank you for your time!

Appendix III: University Ethical Clearance

University Ethical Clearance.pdf

Appendix IV: NIBSS Clearance Letter

NIBSS Permission Letter.pdf

Appendix V: Sample Consent of Participation

Informed Consent.pdf

Appendix VI: Confirmatory Factor Analysis

Principal Component Analysis (PCA) for the instrument

	Components									
	1	2	3	4	5	6	7	8	9	10
Learning to use USSD technology is easy					.777					
It is easy to navigate around the USSD technology					.759					
It is easy to use the USSD technology for banking activities					.589					
The design of the USSD encourages the use of the technology.					.467			.		
The USSD technology has a poor services			.602							
Carrying out transaction activities on USSD saves time	.425							.463		
It is safe from internet fraud when using USSD technology				.810						
The authentication process on the USSD technology is enough				.648						
USSD technology is prone to scam.		.790								
Several people have been scammed by using USSD technology		.741								
It is safe from internet fraud when using USSD technology				.876						
The USSD technology breaks down very frequently						.669				
It is easier to use the USSD technology than internet banking	.494									
The system has failed you multiple times						.629				
The use of USSD technology for transactions depends on the location						.704				
USSD technology activation is easy								.773		
USSD technology usage increase the transactions process										.469
The information on the USSD technology is always accurate									.495	
The features on the USSD technology caters to all financial needs	.408		.453							
USSD lacks enough procedures			.548							
There is a lack of fulfillment when using the USSD technology			.633							
The quality of the USSD technology is very satisfactory	.662									
Use of USSD technology increases the quality of banking transactions	.522									
The USSD technology is a complicated system			.531							
The bank charges for using the USSD technology discourages its usage										.720
The usage of the USSD technology has been engulfed by bad experiences.			.481							
There is a lack of the necessary skills required to use the USSD technology			.426						.539	
There is a lack of support customer care services in USSD technology									.488	
USSD technology provides access to other financial services.	.460									
Usage of USSD technology leads to an effective and efficient financial transactions experience	.632									
The USSD technology gives me greater control over my finances.	.479									
Using USSD technology enables me to carry out more financial transactions	.573									

The USSD is more cost effective compared to the other means of carrying out banking activities (going to the hall or online banking)	.631									
The USSD technology is open to fraud		.754								
The use of 4-digit PIN in plain text discourages the use of USSD for banking		.503								
The USSD technology has built confidence in its usage							.599			
The trust for my bank affects my use of USSD technology							.795			
USSD improves customer loyalty for banking services							.409			
Eigen values	3.662	2.727	2.679	2.399	2.328	1.747	1.650	1.615	1.445	1.302
% Variance	9.638	7.175	7.050	6.314	6.127	4.598	4.342	4.249	3.804	3.426
Cumm %	9.638	16.813	23.863	30.177	36.304	40.902	45.244	49.493	53.297	56.723