

**Evaluating the adoption of Fourth Industrial Revolution (4IR)
related technologies by the Department of Home Affairs**

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**A research report submitted to the Faculty of Commerce, Law and
Management, University of the Witwatersrand, in partial fulfilment of the
requirements for the degree of Master of Management in the field of Digital
Business**

Johannesburg, 2024

DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted for the Degree of Master of Management in the field of Digital Business at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

A handwritten signature in black ink, appearing to read 'Sekie Michael Molobi', is written over a horizontal dashed line.

Sekie Michael Molobi

30 May 2024

ABSTRACT

The aim of this study was to provide insights into the factors influencing the adoption of 4IR technology by the Department of Home Affairs, including the perceived impact of these technologies on general operations and client service delivery.

The Fourth Industrial Revolution (4IR) is a period characterised by rapid technological change and digital transformations, transforming how we live, work, and interact with the world around us. 4IR presents opportunities and challenges for the Department of Home Affairs (DHA) as it attempts to meet its mandate in an ever-changing environment. To remain effective in the face of the 4IR, the DHA must adopt new technologies that can help it improve efficiency and provide better service to its customers and key stakeholders.

The study is based on the Technology Organisation Environment theoretical framework. A qualitative research methodology was adopted with the use of in-depth semi-structured interviews targeted at the Department of Home Affairs senior management personnel responsible for ICT, front end application and internal business owners.

The outcomes of the study indicate that despite continued support from DHA leadership in terms of the use of new technologies and increased investment in these technologies, the Department of Home Affairs has lagged in terms of technological advancement. This is attributed to employee attitude towards new technology, their skill capacity, and resources capacity to conduct and major hindrances towards adopting new technology from an internal perspective. Externally, SITA's capacity to deliver the required services is seen as a major external factor with significant potential to hinder the Department's adoption of new technology.

KEYWORDS

Fourth Industrial Revolution, Technology Adoption, Department of Home Affairs,
Technology-Organisation-Environment Framework

DEDICATION

I dedicate my dissertation to my darling daughter Monthati, who has always motivated me with her unshakeable faith in my skills. Her pure delight and purity have balanced the academic obstacles and served as a constant reminder of the value of resilience and the joy of learning.

To my mother Valentine, whose unwavering support and selflessness have served as the cornerstone of my academic career. Her fortitude and insight have served as a beacon of guidance, moulding my character as well as my academic endeavours.

And to my sister Lesego, whose support and common love of learning have enhanced my adventure. Her confidence in my skills has inspired me and having her around has lessened the isolation of the academic path.

The love, support, and encouragement of a valued and adored family are honoured in this dissertation. I am incredibly grateful and in love with them for their combined impact in helping me reach my academic goal.

ACKNOWLEDGEMENTS

I sincerely thank the Lord, our Savior, for all his support, wisdom, and direction during this academic endeavour. Your kindness has inspired me and given me perseverance.

I would also want to thank my wonderful supervisor, Dr. Kebashnee Moodley, for her help, support, and unfailing faith in my abilities. The guidance and experience of Dr. Moodley have greatly influenced the direction of this study.

I want to sincerely thank Tshegofatso Monama, a friend and mentor who has been very encouraging. His advice and insights have had a significant influence on my academic and personal lives. The bond with Tshegofatso has been a pillar of strength when things have been hard.

I am incredibly appreciative of my family's comprehension, inspiration, and steadfast support. This accomplishment is both yours and mine, and your love has been a continual source of encouragement.

Without the interview subjects' engagement and desire to participate, this research would not have been successful. I would want to thank every one of you for sharing your time, wisdom, and experiences with me; you have greatly enhanced the breadth and depth of this research.

Lastly, I would want to express my gratitude to everyone who helped me finish my dissertation in any manner. This scholarly pursuit has been made rewarding and meaningful by your joint support.

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LIST OF ACRONYMS

4IR	Fourth Industrial Revolution
ABIS	Automated Biometric Identification System
AI	Artificial Intelligence
AR	Augmented Reality
DHA	Department of Home Affairs
ICT	Information and Communications Technology
IoT	Internet-of-Things
NIS	National Identity System
SITA	State Information Technology Agency
TOE	Technology Organisation Environment
TOGAF	The Open Group Architecture Framework.
VR	Virtual Reality

CHAPTER 1: INTRODUCTION

1.1 Statement of Purpose

The Fourth Industrial Revolution (4IR) is a period characterised by rapid technological change and digital transformations, which have transformed how we live, work, and interact with the world around us (Kasza,2019). 4IR presents both opportunities and challenges for the Department of Home Affairs (DHA) as it attempts to meet its mandate in an ever-changing environment. To remain effective in the face of the 4IR, the DHA must adopt new technologies that can help it improve efficiency and provide better service to its customers and key stakeholders (Nokele & Mukonza, 2021).

This study aimed to provide insights into the current state and level of adoption of 4IR technology by the Department of Home Affairs, including the perceived impact of these technologies on general operations and client service delivery. A qualitative research methodology was adopted to gather relevant data via interviews with key stakeholders.

The outcomes of this research are significant for three reasons. Firstly, it provided evidence-based recommendations for improving the adoption of 4IR technology at DHA by identifying factors that enable or hinder implementation and providing appropriate solutions based on known best practices to enhance adoption. Secondly, the insights produced by the research aided in strategic planning, policy development, and operational choices at the DHA and other entities as it relates to digital transformation. Lastly, this research contributed to the broader knowledge base as it relates to the adoption of 4IR technology by a government entity in a developing country.

1.2 Background of Study

The Fourth Industrial Revolution (4IR) has brought about a significant paradigm shift in industries and has revolutionised the way organisations operate and interact with their clients (Kasza,2019). The Information Communication Technology (ICT) landscape is undergoing rapid digital transformation associated with the adoption of innovative technologies such as Artificial Intelligence (AI), blockchain, robotics, and the Internet of

Things (IoT). According to Peters and Trunschke (2021), these innovative technologies have demonstrated a remarkable potential to improve accuracy, increase security and boost organisational efficiency across various industries.

In this context, the Department of Home Affairs (DHA), which is the custodian of South Africa's citizenship identity management systems, manages immigration and citizenship processes and is also responsible for the issuing of identity documents, passports, and visas through a complex process involving administrative tasks, large volumes of data, requiring a high level of accuracy and security has the potential to benefit from the adoption of 4IR technologies. The services provided by DHA are vital as they enable citizens and foreigners to exercise their rights to gain access to benefits in both the public and private sectors, such as opening a bank account or being admitted to schools.

The South African government has recognised the importance of embracing 4IR technology by articulating it in its key policy documents, such as the National Integrated ICT Policy White Paper published in 2016. The white paper recognises the importance of creating an environment that enables the adoption and implementation of 4IR technologies within the state in order to improve services delivery, increase economic growth and improve South Africa's competitiveness in the global market (Department of Telecommunications and Postal Services, 2016). Furthermore, it acknowledges the need to remove barriers that can negatively affect the adoption of 4IR technologies, such as lack of infrastructure, restrictive policy/regulative framework, and skills development (Department of Telecommunications and Postal Services, 2016).

In 2019, the President of South Africa established the Presidential Commission on the Fourth Industrial Revolution, further indicating the importance and need for the state to adopt the use of 4IR technologies. The commission was established to assist the South African government in identifying relevant strategies and policies that can enable it to leverage the opportunities associated with 4IR technologies and become globally competitive.

Although the South African government, in principle, encourages the adoption of 4IR technologies, adopting and integrating 4IR technologies into a government entity such as DHA poses numerous socio-technical challenges. Organisational and cultural factors, a lack of technical skills, and inadequate infrastructure are some of the factors that can negatively affect the adoption of new technologies within an organisation. The aim of the study was to identify and unpack the socio-technical issues that have an impact on the adoption of 4IR technology by government Departments. Thus, DHA and other government Departments can use the insight gained from the study to improve and better structure the implementation of 4IR technology to ensure complete adoption.

1.3 Research Problem

Department of Home Affairs provides citizens and foreigners with essential services that enable them to access additional public and private services. Recently, the Department has received media attention for long queues, extended delays in issuing appropriate documentation, and issuing documentation with errors and corruption (Motloun, 2023; Hawker, 2023 Chabalala, 2023). This has resulted in many citizens and foreigners not being able to access relevant opportunities.

The Department has deployed numerous forms of technology, such as an electronic booking system to avoid long queues, an Automated Biometric Identification System (ABIS), and a National Identity System (NIS) to attempt to automate, secure, and maintain the identity information of South Africans. However, regardless of the technological advancement the Department continues to make over the years, there is anecdotal evidence supported by media coverage that indicates that the deployment of these technologies did not have the desired impact on service delivery or operational efficiency (Daniels, 2022) (Githahuc, 2021) (Moloi, 2022).

It can be argued that the Department currently faces a challenge in terms of technology adoption, as the deployment of new technology does not yield the desired outcomes. It is, however, worth noting that scholars such as Rogers (1962), Davis (1989), and Venkatesh et al. (2003) have developed technology adoption theories and frameworks

that attempt to explain why and how new technology ultimately gets accepted and utilised by its intended end users. These theories and frameworks can provide valuable insights into why the adoption of certain technologies has been difficult.

The plug-and-play approach regarding deploying new technology assumes that the new technology being deployed has all the features in terms of functionality and integration and would not require any further customisation. This type of approach toward the deployment of new technology has proven to be ineffective. According to Brynjolfsson (1993) If technology is not properly integrated and adopted by an organisation, it has the potential to exacerbate the issue or process that it was trying to resolve or optimise. This would further have service delivery and cost implications for the organisation (Brynjolfsson,1993).

1.4 Research Objectives

The study aimed to evaluate the adoption of the Fourth Industrial Revolution (4IR) technology by the Department of Home Affairs, focusing on understanding the status, identifying challenges and benefits, and providing recommendations for effective implementation. For the aim of this study to be achieved, the following objectives need to be realised:

- To identify the type of 4IR technology currently used by the Department of Home Affairs.
- To assess the general knowledge regarding technology adoption methodologies or framework
- To examine the perceived impact of 4IR technologies on overall operations and service delivery of the DHA.
- To identify the key factors influencing the adoption of 4IR technology by the DHA.
- Provide recommendations on measures that can be taken to improve the DHA implementation and adoption of new technologies.

1.5 Rationale

The South African government has identified improving service delivery as a top priority since it is considered crucial for fostering social and economic development. However, according to Joel (2022), Umezurike and Isike (2013) the DHA has had difficulty achieving its service delivery goals, which has hurt both the quality of life for residents and economic development. 4IR technologies, if properly implemented and adopted, are seen as potential solutions for addressing some of the service delivery challenges.

This study was significant in two ways; firstly, it identified factors that negatively impacted the Department's adoption of 4IR technology, thus providing evidence-based recommendations for improving the adoption of new 4IR technology. This could lead to increased operational efficiency and improved service delivery. Secondly, this study provided further knowledge on how developing countries such as South Africa are adopting 4IR technologies within the government context. The study also provided new insights as it relates to the nexus of 4IR technology and technology adoption models or theories in the context of a government Department.

The insight gained from this study can further inform the development of evidence-based policy and regulations that support the effective and efficient implementation of new technologies within the public sector. Additionally, the study provides suggestions for future exploration and application in this field.

1.6 Delimitation of the Study

- Scope of the research: The research project's focus was solely on the DHA and the provision of its services in South Africa considering the Fourth Industrial Revolution. The focus was on the national office and large regional offices. The results and recommendations may not immediately apply to other government Departments.
- Availability and reliability of data: The research relied on existing data and information from secondary sources, such as peer-reviewed articles, reports, and publications. The availability, quality, and reliability of these data sources may have impacted the accuracy and validity of the proposed research.

- **Language:** There are 11 official languages in South Africa. The suggested study's research tool was only available in English. Therefore, the interviews were only open to individuals who were fluent in English.

1.7 Definition of Terms

Fourth Industrial Revolution: The current stage of technological development, known as the Fourth Industrial Revolution, is characterised by the application of digital technologies, automation, artificial intelligence, big data, and the Internet of Things (IoT) to a variety of societal domains, including the economy, industry, governance, and daily life.

Department of Home Affairs (DHA): A government Department in South Africa in charge of several tasks, including immigration, citizenship, identity management, civil registration, and other things having to do with how individuals move about and have their position within the borders.

Service delivery: To address the requirements of people, residents, or other stakeholders, government agencies or organisations must supply services. In the context of the study, "service delivery" particularly refers to the services offered to people and other stakeholders by the South African Department of Home Affairs, such as the issuance of birth certificates, passports, identity verification, and other associated services.

Technology adoption: The process of integrating and exploiting new technologies inside a company or industry is referred to as technology adoption. The Department of Home Affairs in South Africa has embraced digital technology, automation, and other technological advancements in its operations.

Digital transformation: Digital transformation is the process of transforming and improving organisational processes, operations, and service delivery via the use of digital technology. It relates to the Fourth Industrial Revolution's influence on service delivery

and how the South African Department of Home Affairs has experienced or is experiencing a digital transformation.

1.8 Assumptions

The following assumptions were considered within the study:

- All the key stakeholders who were part of the study in the form of interviews were honest and transparent.
- All individuals who participated in the study had some level of understanding of 4IR technologies.
- It was assumed that there was a common understanding/definition regarding the use of technical terms.
- It was also assumed that all the participants had some level of digital literacy or had undergone specialised training.

1.9 Chapter Outline

This study was presented in the form of six chapters that aimed to evaluate the adoption of 4IR technology by the Department of Home Affairs. The content of each chapter is summarised below:

Chapter 1: Introduction

This chapter provides the introduction and background to the study. It also discusses the study's problem statement, the research purpose and objectives, the definition of key terms, and how the entire research dissertation will be structured.

Chapter 2: Literature Review and Conceptual Framework

This chapter provides an extensive literature review on the 4IR technologies with a focus on factors that impact the adoption and potential opportunities that can be gained by government Departments if appropriately adopted. The chapter also provides some insights into technology adoption models and a recommendation for a conceptual framework for the study.

Chapter 3: Research Methodology

This chapter provides an overview of the research methodology used in this study to address the research aim and objectives. This chapter also elaborate on the data collection, sampling, targeted population, and data analysis techniques used.

Chapter 4: Research Results

This chapter provides insights into the study's results that the researcher obtained via the approach articulated in chapter three.

Chapter 5: Discussion of Results

This chapter provides an interpretation of the results from chapter four in the context of the study by discussing how the results are aligned with the study's aim and objective. The researcher's overall general interpretation of the overall results will also presented in this chapter.

Chapter 6: Conclusion and Recommendation

This chapter provides an overall summary of the study and recommendations on how the Department of Home Affairs can improve future technology implementation based on the study's findings. Recommendations for future studies was also be proposed.

CHAPTER 2: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

This chapter reviews the existing literature on the Fourth Industrial Revolution and its associated technologies; furthermore, the chapters also explore in detail the concept of technology adoption models or frameworks, focusing on works relevant to the present research aims and objectives. This chapter also provided insights into the study's theoretical framework.

2.2 The Fourth Industrial Revolution (4IR)

Academics and experts in history have conducted extensive analyses and classifications of significant economic and technological transitions that have occurred throughout human history, leading to the popular concept of industrial revolutions. Nevertheless, there remains a lack of agreement regarding the sources that first described the initial three industrial revolutions (De Vries, 1994). The description and classification of the Fourth Industrial Revolution is, however widely credited to Xu et al., (2018) and Philbeck and Davis (2018).

The First Industrial Revolution is often credited with introducing a significant shift away from the traditional reliance on animals, humans, and biomass for energy. This shift was made possible by the innovation of fossil fuels and mechanical power (Olaitan et al, 2021). In the late 1800s and early 1900s, the second industrial revolution began, characterised by notable advancements in electricity distribution, wireless and wired communication, and the development of new methods of power generation (Olaitan et al, 2021). Subsequently, the third industrial revolution, which according to Olaitan et al. (2021) took place in the early 1950s, was marked by the advent of digital systems, communication, and considerable progress in computing power. These advancements have paved the way for novel approaches to generating, processing, and disseminating information (Olaitan et al, 2021).

According to Schwab (2015), the Fourth Industrial Revolution is not merely an extension of the Third Revolution, which is attributed to the digital revolution that commenced in the mid-20th century. Schwab (2015) further states that this current industrial revolution is characterised by a convergence of technologies that blurs the boundaries between physical, digital, and biological domains. The uniqueness of this revolution is attributed to three factors namely speed, scope, and system impact (Schwab, 2015). The unprecedented speed of technological advancements is exponential, setting it apart from previous industrial revolutions. Furthermore, it is causing significant disruptions in nearly every industry and country (Pricecaru, 2016). The breadth and depth of these changes signify a shift towards a transformative era. Table 1 summaries the key characteristics of the different industrial revolutions:

Table 1: Key characteristics of industrial revolutions (adapted from Prisecaru, 2016)

Industrial Revolution (IR)	Period	Transition Period	Energy Source	Main Technology	Main Developed Industry
1 st IR	1760-1900	1860-1900	Coal	Steam Engine	Textile, Steel
2 nd IR	1900-1960	1940-1960	Oil / Electricity	Internal Combustion Engine	Metallurgy, Auto, Machine Building
3 rd IR	1960-2000	1980-2000	Nuclear Energy / Natural Gas	Computers, Robots, Internet	Auto, Chemistry
4 th IR	2000-Present	2000-2010	Green Energies	Artificial intelligence, 3d printing, Internet of Things (IoT)	High Tech Industries

2.3 4IR Technologies

Several emerging technologies are associated with the Fourth Industrial Revolution, however, for this study, the focus was on technologies that are aligned to the mandate and activities of the Department of Home Affairs. Thus, the study focused on the following technologies: Artificial intelligence (AI), robotics, and blockchain.

2.3.1 Artificial Intelligence

According to Helm et al. (2020), the term “artificial intelligence” originated in the 1950s and referred to a theory where machines could show human-like intelligence. Under an unprecedented, rapidly advancing technology, artificial intelligence has transformed from a theory to a practical reality. Artificial intelligence in the modern era is defined as the capacity of a given system to accurately interpret and analyse external data, derive pertinent insights from it, and effectively achieve pre-established goals through adaptable strategies informed by these insights (Kaplan & Haenleim 2019).

AI technology has multiple potential uses within the Department of Home Affairs, for example, document authenticity verification and language translation. Such technology could fast track the visa-issuing process. Furthermore, analytics can be run on the information supplied to identify unusual travel patterns or discrepancies in the information provided (Rudner, 2008). This would aid in risk assessment and potential fraud detection. Other common AI usage include faster more accurate facial recognition and biometric identification (Romero-Moreno, 2021).

2.3.2 Robotics

Robotics is a sub-discipline of engineering focused on designing, constructing, and usage of machines to perform predefined tasks (Merriam-Webster, 2023). The use of robotics originates from the 3rd industrial revolution and was mainly implemented in car production factories. Liu *et al.* (2019) states that robotics in the 4IR incorporate AI to make them more autonomous, a characteristic not evident in 3IR robotics. Furthermore, the use of robotics under the 4IR goes beyond production factories and has infiltrated homes and businesses (Liu et al., 2019).

Through robotic process automation, the Department can offer some of its basic client-facing tasks such as answering basic queries, ensuring that the clients have the relevant documents required to complete a task, etc. This has the potential to reduce waiting time and improve service delivery (Chigwada & Chisita, 2021). This technology has been proven viable and has already been implemented in a library context at a South African university (Chigwada & Chisita, 2021).

2.3.3 Blockchain

Blockchain is a technology that facilitates decentralised and distributed record-keeping, enabling secure and transparent transactions or data transfer across multiple nodes or participants (Hou, 2017). Caradonna (2020) states that the technology operates through a series of blocks, each containing a set of transactions or data and interconnected through cryptographic hashes to the preceding block. This creates an immutable and tamper-resistant record that ensures the integrity and trustworthiness of the information being shared. According to Iyer (2018), the technology gained popularity with the rise and use of cryptocurrencies such as Bitcoin.

The use of blockchain technology can have a significant impact on the identity management system of the DHA. With the technology, the Department will be able to issue digital identities that would result in increased security of personal information and identity, streamlined verification and authentication of identities, and a potential reduction in identity theft (Alanzi & Alkhatib, 2022). This is possible because the technology can provide a highly secure tamper-resistant platform that is not centralised and hence not vulnerable to hacking or data breaches (Hou, 2017). The decentralised storage approach ensures that the risk of authorised access is reduced and thus increasing data privacy (Alanzi & Alkhatib, 2022). Thus, a person's identity information can be encrypted, split, and stored across multiple nodes in a network (Hou, 2017).

Due to the traceability, transparency, and tamper-resistance nature of blockchain technology, it also has potential uses in public finance management and supply chain

management. The technology will allow for more improved transparency and accountability in public services as it rates the procurement process and the general use of state funds (O'Leary, 2017). This would result in a potential reduction of corruption and fruitless, wasteful expenditure by the Department.

2.4 Opportunities and Challenges of 4IR

The arrival of the Fourth Industrial Revolution brings about many opportunities as it relates to how people work. According to Magwentshu et al (2019), process automation and AI have been shown to increase general productivity. The integration of AI technology to automate repetitive and time-consuming tasks provides a significant advantage to human workers, enabling them to focus on more complex and creative tasks that demand advanced cognitive abilities. Additionally, Hao et al (2023) state that AI systems can supplement human capabilities by offering valuable insights, recommendations, and support based on outputs produced by AI. The benefits of AI integration include increased operational efficiency, reduced costs, improved customer satisfaction, and increased innovation (Magwentshu et al, 2019).

In the biotechnology and medical fields, AI has not only been used for fast accurate diagnosis but also drug discovery and administration purposes. This enables fast, accurate diagnosis even when a specialist is unavailable. The technology also reduces the time it takes to develop medical treatment in the form of vaccines or medication (Kumar & Saha, 2022) this would ultimately improve the general quality of life for people.

The 4IR also brings about the development of new markets, industries, and careers that previously did not exist. The technology has also lowered the barrier to entry for tech entrepreneurs by reducing the cost of prototyping and computing with 3D printing and cloud computing platforms (Shaikh et al., 2020).

Although the 4IR brings about many opportunities due to its pervasive and disruptive nature in how people work and live, it also brings about new challenges. Abe et al., (2021) argued that although automation from 4IR technology leads to greater productivity, it has

the potential to lead to large-scale job losses, which could have major negative social-economic impacts. 4IR technologies are advancing and evolving at an exponential rate, thus potentially increasing inequality due to the digital divide created by a lack of access to technology or relevant skills (Adams, 2021).

The deployment of autonomous systems like cars and drones brings about ethical challenges relating to accountability and responsibility. Bench-Capon (2020) argues that apart from autonomous systems, unwarranted biases that lead to the discrimination of a group of people due to machine learning algorithms developed with inappropriate training datasets pose ethical challenges regarding the use and fairness of such technologies. As the technologies advance, the issues become more prominent (Bench-Capon, 2020).

Modern devices are increasingly becoming more connected and, in some instances, passively capturing a wide variety of information. The information is often stored and analysed to improve user experience and product offerings. The fact that the information is captured passively without the knowledge and consent of the owner poses privacy and data security issues (Mofokeng, 2019).

2.5 4IR on the South African Government

Although the South African government has continually embraced the 4IR technology, it finds itself in a unique situation where it is required to act as both a player and a referee (Ostrowick, 2021). As a referee, the Government is under pressure to draft and pass appropriate policies and legislation that would not only fast-track the adoption of 4IR technology by the state and private sector but still ensure data sovereignty and protect its citizen's privacy (Bayode et al, 2019). The National Data and Cloud Policy is an example of a government initiative in that regard. The policy is aimed at creating an enabling environment where the government can take full advantage of the cloud services to hence services delivery while ensuring data sovereignty and security. Most 4IR technologies rely on cloud technology for data storage and analytics.

According to the Presidential Commission on the 4th Industrial Revolution report (2020) the state is also required to ensure that appropriate telecommunication infrastructure is in place that can support the functioning of these technologies. Government initiatives such as the SA Connect program and migration to Digital Terrestrial Television (DTT) are, but a few initiatives targeted at increasing broadband capacity and penetration to allow for the use of 4IR technology such as Internet-of-Things (IoT) (Motsaathebe & Chiumbu, 2021). Under the competing priorities because of the socio-political history of the country, the provision of ICT infrastructure has often been slow.

The South African government is the largest employer, with approximately 1 230 835 employees as of 14 February 2022 (Gabara, 2022), it is subsequently the largest consumer of information technology products and services in the country (Mordor Intelligence, 2022). Thus, the disruptive nature of 4IR directly impacts the government as a player. The emergence of new technology is slowly altering how it performs its business and offers services to its citizens (Plantinga & Adams, 2021).

For the South African government to provide improved service delivery to its clients and be globally competitive, it requires that the adoption of 4IR-related technologies be accelerated both within the country from the private sector perspective and within the government. The adoption and use of these technologies are no longer a luxury reserved for the selected few but are slowly becoming a prerequisite for participating in the digital global economy.

2.6 The Department of Home Affairs

The mandate of the DHA is derived from the Constitution of the Republic of South Africa, 1996, and various Acts of Parliament and policy documents such as the Births and Deaths Registration Act, the Identification Act, the South African Citizenship Act, and the South African Passports and Travel Documents Act (Mokoena, 2022).

The DHA plays a crucial role in safeguarding the identity and status of citizens and residents in South Africa. By fulfilling this responsibility, people can enjoy their rights and

access various benefits and opportunities in both the public and private sectors. Additionally, DHA regulates and manages immigration and the movement of individuals across all ports of entry. It provides immigration and civics services to foreign missions and determines the status of refugees and asylum seekers in compliance with international obligations. The Department's efforts contribute significantly to national security, economic development, and positive international relations. More details on the provision of civic and immigration services are available in Table 2 below (Mokoena, 2022).

Table 2 Immigration and Civic services offered by DHA (Mokoena, 2022)

Immigration Services	Civics Services
Determining the residency status of foreigners and issuing permits thereof	Maintaining the National Population Register (NPR)
Administering admissions into the country	Managing the birth, marriage, and death records
Custodianship of refugee affairs	Determining and granting citizenship
Developing policy directives relating to immigration matters	Issuing travel documents and passports
Monitoring compliance with immigration policies and legislation	Issuing identity documents (ID)

The Department of Home Affairs operational activities are in numerous sites and within different entities or organisation. The Department has a national head office with 412 regional offices that report to nine provincial offices. The Department also has approximately 100 mobile units that can be used in deep rural areas to provide civics services (Mokoena, 2022). DHA also has a presence at 72 ports of entry (Mokoena, 2022).

Mokoena (2022) states that a total of 26 banks nationwide have been integrated into the DHA which enables them to offer frontline services as it relates to the issuing of smart IDs. VFS Global with 12 offices in 9 provinces is contracted to offer frontline services to foreign nationals by issuance of visas (Mokoena, 2022).

2.7 Factors Influencing the Adoption of 4IR Technologies

Specific prerequisites must be met to facilitate the smooth integration and utilisation of 4IR technologies. This study identifies infrastructure, education, policy, and regulatory framework as the three key factors having the most significant impact as it relates to the adoption of 4IR technologies.

2.7.1 Infrastructure

The role of infrastructure is crucial in the adoption and utilisation of 4IR technology. AI and IoT, which are part of 4IR, heavily rely on connectivity for their optimal performance. Therefore, it is essential to have fast and stable broadband connectivity to ensure the widespread adoption of these technologies (Olaitan et al., 2021).

Data centres play a crucial role in supporting the advancements of 4IR technology. They not only provide storage for data but also enable cloud computing. It is essential to have enough data centres equipped with the latest technologies to manage the ever-increasing volume of data generated by these technologies (Shamsi et al, 2013). Additionally, the necessary analytics must be conducted on the captured data to ensure a satisfactory user experience (Olaitan et al., 2021).

A reliable and continuous source of electricity is crucial to fuel all the necessary technologies. According to Olaitan *et al.* (2021) the Fourth Industrial Revolution (4IR) cannot be fully achieved without a steady power supply. However, it is important to acknowledge that data centres are notorious for their high-energy consumption, both for operating the machines and for regulating their temperature (Olaitan et al., 2021).

2.7.2 Policy and Regulatory Environment

The government needs to draft innovative, friendly policies that can create an enabling environment that allows for tech entrepreneurship and promotes innovation in the ICT space. This will ensure that the government can take advantage of the potential economic benefits associated with 4IR technology development and adoption (Nyagadza et al, 2022). Intellectual property rights such as patents and copyrights need to be amended to align with technological development to protect the rights of original inventors or developers of new technology (Ncube & Rutenberg, 2021).

Ostrowick (2021) states that due to the large volume of data produced by 4IR technologies, data policies, and regulations need to be formulated to address privacy, security, and ethical concerns associated with the use of these technologies. Furthermore, Ostrowick (2021) is of the view that failure to pass appropriate policies and regulations would result in litigation and potential misuse of technologies.

According to Azionya (2022) to create a competitive market that supports 4IR technology development, regulations that hinder monopolies and encourage fair competition among companies need to be in place. This will ensure that consumers have more choices that are competitively priced and that tech companies are incentivised to be more innovative (Azionya, 2022).

2.7.3 Education

Education plays an important role in terms of ensuring that the workforces possess the appropriate digital literacy skills to not only utilise the technology but also to ensure that the technology is maintained and, in some cases, further developed or advanced. Abe et al (2021) state that due to the rapid pace of technological advancements of 4IR technologies, continual lifelong learning mindsets are required amongst the workforce to stay abreast of new technological developments. Without appropriate education, 4IR cannot be adopted or progressed (Abe et al., 2021 and Magwentshu et al, 2019).

2.8 Technology Adoption Models

Technology adoption models or theories are theoretical frameworks that attempt to explain the process and factors that influence the acceptance, adoption, and integration of new technology by either individuals or organisations (Dube et al, 2020). These Models can assist organisations, policymakers, and researchers in understanding factors that affect technology adoption, this leads to improved technology design and better strategy development that allows for better implementation and adoption of new technology (Dube et al, 2020).

2.8.1 The Innovation Diffusion Theory

Everett Rogers developed the Innovation Diffusion Theory in 1962 as a sociological framework that explains how, why, and at what rate new ideas and technologies spread through a population. The theory is based on four main elements namely the innovation itself (technology, new ideas), the communication channels, time, and the social system (Saygili et al, 2021). The theory assumes that not everyone adopts innovations at the same time but rather by different groups of people who possess similar characteristics and preferences (Saygili et al, 2021). The theory also identifies five stages of adoption namely knowledge, persuasion, decision, implementation, and confirmation (Saygili et al, 2021). Furthermore, Bakkabulindi (2014) states that the theory also identifies five characteristics of innovations that influence their adoption which are relative advantage, compatibility, complexity, trialability, and observability. Innovations or technology that are perceived to have a higher relative advantage, compatibility, and trialability, and are less complex and more observable, are more likely to be adopted (Bakkabulindi, 2014).

2.8.2 The Theory of Reasoned Action

The theory of reasoned action has its origins in the field of psychology and was developed by Martin Fishbein and Icek Ajzen in 1975 (Dube et al, 2020). According to Lai (2017), the theory proposed that attitudes and beliefs influence behaviour. In the context of technology adoption, the theory suggests that an individual's intention to use a specific technology is influenced by their attitude towards the technology and their general moral beliefs about what they should be doing Lai (2017).

2.8.3 Theory of Planned behaviour

Lai (2017) states that the theory of planned behaviour is an extension of the theory of reasoned action and was also developed by Fishbein and Ajzen. In the theory of planned behaviour, a third factor, perceived behavioural control is added to the original two factors that made up the theory of reasoned action. The perceived behavioural control factor relates to the individual's belief about their ability to use the new technology Lai (2017).

2.8.4 Technology Acceptance Model

The technology acceptance model was developed by Fred Davis in 1986 and aims to explain how individuals perceive and adopt new technologies. According to Dube et al (2020), the perceived usefulness and perceived ease of use are key factors that influence the adoption of new technology. Technologies that are perceived to be useful and easy to use often have a high adoption rate (Dube et al, 2020).

2.8.5 The Unified Theory of Acceptance and Use of Technology

Venkatesh et al. (2003) developed the unified theory of acceptance and use of technology by integrating and extending the technology acceptance model and the theory of reasoned action. The model proposes that the following factors affect the use and adoption of new technology Venkatesh et al. (2003):

- Performance expectancy: The individuals perceived performance improvement because of using the new technology.
- Effort Expectancy: The individuals perceived ease of use and learning about the new technology
- Social influence: The individual's perception of how influential accepts the general use of the technology by the public and by the individual.
- Facilitating Conditions: The individual perception of whether they have the required resources and support to continually use the technology

The theory also acknowledges the effects of age, gender, and experience on the adoption of new technology (Venkatesh et al, 2003).

2.9 Theoretical Framework

The study made use of the Technology-Organisation-Environment (TOE) Framework as a theoretical framework that was used for evaluating the adoption of 4IR technology by the Department of Home Affairs. The TOE framework offered a broader perspective in terms of technology adoption when compared to previously stated technology adoption models. Technology adoption models focus on technology adoption at an individual level, while TOE focuses on technology adoption at an organisation level.

The TOE framework was developed by Tornatzky and Fleischer in 1998 as a technology adoption framework that focuses on adoption at an organisation level as opposed to the individual level. The framework proposed that technology adoption is influenced by the interaction and interdependence between three factors, namely technology, organisation, and environment (Bryan & Zuva, 2021). Furthermore, successful technology adoption requires alignment between the three factors. In the context of TOE, the three factors represent the following (Bryan & Zuva, 2021):

- Technology: This refers to the characteristics of the technology, such as ease of use, functionality, complexity, and compatibility with existing systems.
- Organisation: This refers to internal organisational factors such as the size of the organisation, organisation culture, structure, resources, and prior experience of adopting new technology where the new technology is to be adopted.
- Environment: This refers to the external environment under which the organisation operates. External environment factors include regulatory requirements, industry standards, market dynamics, and availability of external support.

This framework has been used to study the adoption of technology in various industries. Sulaiman and Magaireah (2014) used the framework to study the adoption of electronic health record systems in hospitals, while Mujahed et al. (2022) used it to study factors influencing Palestinian small and medium enterprise's intention to adopt mobile banking and Wang et al. (2010) used it to study the factors influencing the adoption of radio frequency identification in the manufacturing sector.

The Department of Home Affairs operates as part of a broad complex system comprising other government Departments, internal staff, service providers, etc. Adopting new technology needs to consider these role players and numerous factors such as organisational structure, resources, capabilities (internal and external), and external environment. The TOE framework takes into consideration these factors; hence it is the preferred approach over other technology adoption models that are mainly focused on the adoption of new technology at an individual level.

2.10 Chapter Summary

This chapter presented the literature review conducted for the study by firstly defining the Fourth Industrial Revolution (4IR) and its associated technologies and examining opportunities and challenges associated with the technology. Secondly, the chapter further discusses the impact of 4IR on the South African government, with a focus on the Department of Home Affairs. The concept of technology adoption models is introduced as an approach to systematically studying technology adoption. The chapter concludes by adopting TOE as a theoretical framework for the study.

The next chapters present a methodology and data analysis approach that was followed to achieve the set aim and objectives of this study

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

The purpose of this chapter was to present the research methodology adopted to achieve the aim and objectives of the study. This chapter also highlights the data collection methods, sampling techniques, population, and data analysis techniques used to analyse the data collected.

3.2 Research Approach

To achieve the aim and objectives of the study, a qualitative research approach was implemented. According to Ericsson (1990), qualitative research involves collecting and analysing non-numerical data such as text, images, videos, and audio to understand a specific phenomenon of interest. Qualitative research aims to provide an in-depth and holistic account of complex phenomena through the contextual perspective of the individuals being studied (Ericsson, 1990)

This study aimed to not only describe the type and level of adoption of 4IR technology but also to understand the factors that influence the adoption of these technologies and the perceived impact these technologies could have on the Department of Home Affairs' operation and service delivery. The qualitative research method allowed for the collection and analysis of complex contextual data to understand people's experiences, perspectives, and concepts about a particular phenomenon (Brown-Martin, 2017) and, in the context of this study, the adoption of 4IR technology within DHA.

3.3 Research Design

The study's research design was based on a qualitative research approach that followed an explanatory design. According to Saunders et al. (2016), in an explanatory qualitative research design, qualitative data is collected and analysed to understand and explore the meanings, experiences, and perspectives of a specific phenomenon under study. The explanatory qualitative research design can be used to answer "What?" "Why?" and

“How?” questions regarding a phenomenon being studied from the perspective of the individuals being studied (Saunders et al., 2016).

The explanatory qualitative research design was appropriate for this study as it enabled the researcher to identify key factors influencing technology adoption (through what?) and understand how these factors hindered or enabled adoption (through How? And why?).

3.4 Data Collection Method

Hox and Boeije (2005) define primary data as new data collected for a specific research question using the data collection methods that are appropriate for answering the set research question, while secondary data is existing data that was initially captured for a specific research purpose but can also be used for a different research study. The data collection for this study focused on collecting qualitative primary data.

Semi-structured interviews were used to collect the qualitative data for this study. According to Williamson (2013) in semi-structured interviews, the researcher uses open-ended structured questions to collect data. This approach allowed the researcher to capture complex, in-depth information about the questions and the reasons behind the given answers (Williamson, 2013).

Primary data collection through interviews was conducted because the research question and context of the study required the collection of complexes, rich data, which interviews can capture so that the study obtained sufficient data and insights to address the aim and objective of the study.

3.5 Population and Sample

3.5.1 Population

The study aimed to assess the extent of adoption and key determinants of 4IR technologies within the Department of Home Affairs. The study focused on DHA senior management personnel who work in units associated with ICT at the Department.

According to Hagsten and Sabadash (2017), ICT employees play a crucial role in the identification and integration of 4IR technologies within an organisation.

3.5.2 Sample and Sampling Method

This study used a non-probability purposive sampling method which is also referred to as judgmental sampling. The non-probability purposive sampling method is a sampling technique where all the participants selected have a similar characteristic that the researcher required for the study (Etikan & Bala, 2017). In the study, all participants were DHA senior management personnel who lead the ICT Department or directorate. Senior management personnel play a critical role in the adoption of new technology as they bridge the gap between executive management and end user of the technology.

According to Saunders et al. (2016), qualitative studies that use non-probabilistic purposive sampling methods do not have a set number in terms of sample size. Creswell (2014) proposes that qualitative research should have a maximum of twenty-five participants while Hennink et al. (2017) argue that six participants are sufficient to enable a researcher to develop meaningful themes and useful interpretations in a study where the population has a high-level of homogeneity. Hennink et al. (2017) cite data saturation as a reason for the lower sample size. Data saturation occurs when the acquisition of additional information does not yield additional insights (Hennink et al., 2017). Considering this, this study consisted of a sample size of 12 participants.

3.6 Research Instruments

The study used semi-structured in-depth interviews structured in line with the TOE Framework. This approach was in line with the study's research approach and design. The semi-structured interview consisted of three main sections. Section 1 was questions aimed at collecting the respondents' demographic information. Section 2 was questions aimed at determining the participants general knowledge on technology adoption models or frameworks. Section 3 followed the TOE framework and consisted of questions grouped into three main sections or themes, namely *technology*, *organisation*, and *environment*. The questions asked under each theme were structured in a manner that they aligned to the theme sub characteristics of the TOE framework.

3.7 Procedure for Data Collection

An email requesting a 30-minute virtual meeting was sent to the appropriate sample group. The Interviews were conducted virtually via the Microsoft Teams Platform in English. This was the preferred option as it is widely used and has the functionality to not only record but to transcript the virtual meeting. The transcription was edited for completeness and context purposes, and all personal information identifying the interviewee was removed. The transcription was standardised to follow a set template which is attached as Appendix F.

3.8 Data Analysis Strategy

The analysis was conducted in a phased approach. Firstly, a framework analysis was conducted, followed by a thematic analysis. A framework analysis, according to Furber (2010), is a qualitative data analysis method that involves analysing data using a predefined structure or framework. The framework in the context of this study was the TOE framework that assisted in determining the initial themes or categories for the study. According to Clarke et al. (2015), thematic analysis is a qualitative data analysis where researchers study the data and identify common patterns or themes. The thematic analysis was used to further summarise the data that is contained in the initial themes or categories developed during the framework analysis.

Qualitative coding is the process of systematically grouping qualitative data, such as excerpts, to uncover themes or patterns in the data (Azungah, 2018). This study utilizes two qualitative coding strategies: deductive coding and inductive coding. Deductive coding involves using predetermined themes or codes to categorize data, while inductive coding entails deriving themes or codes from the data. The deductive coding approach is employed in the framework analysis, as the themes have already been predetermined (TOE), while inductive coding is used in the thematic analysis process to summarize the data contained in the subthemes.

Figure 1 below illustrates the conceptual framework created by the researcher for evaluating the adoption of 4IR technologies within the Department of Home Affairs. The illustration only covers the main themes and sub-themes.

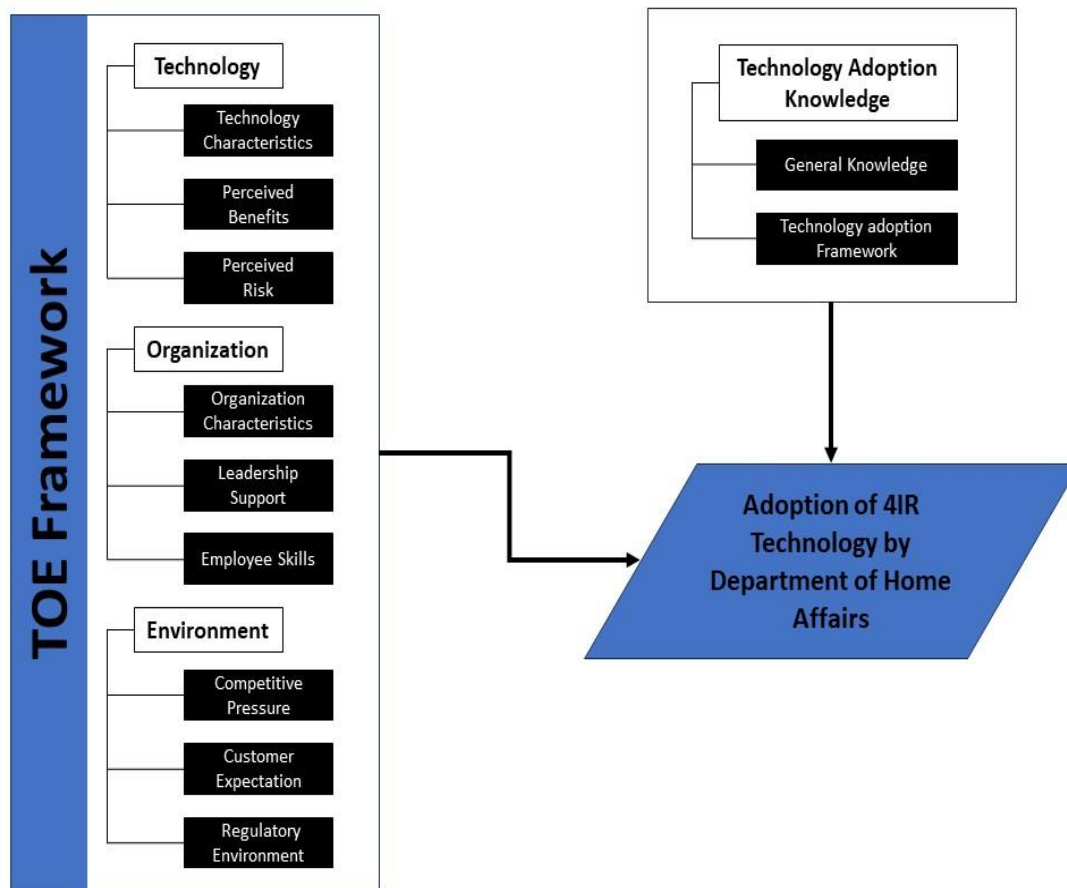


Figure 1: Conceptual framework for evaluating the adoption of 4IR technologies within the Department of Home Affairs

3.9 Data Analysis Process

The data collected for this study was analysed using NVivo 14. NVivo is a computer-assisted qualitative data analysis software developed by QSR International (Dhaka,

2022). The analysis process followed is summarised and illustrated in Figure 2 below (created by the researcher).

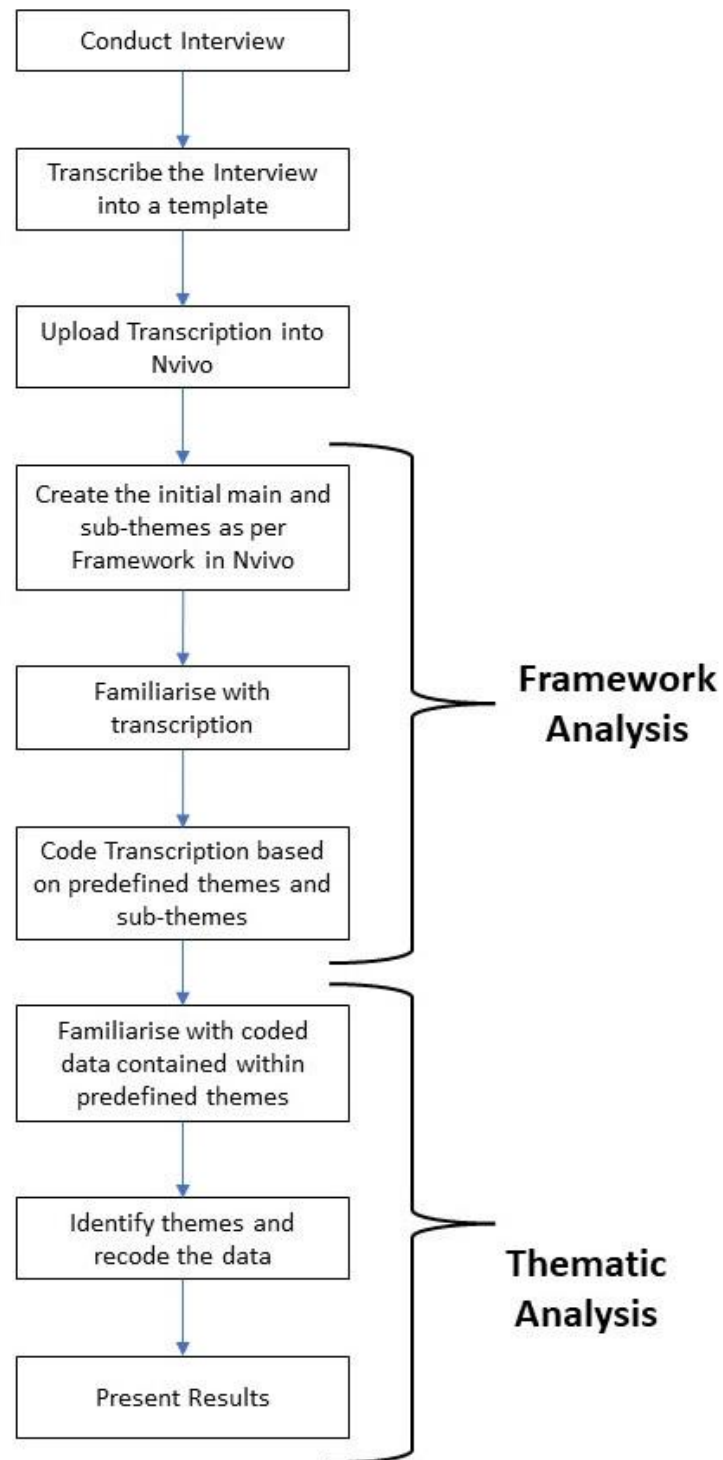


Figure 2: Graphic illustration of the data analysis process.

3.10 Quality Assurance

In research contexts, quality assurance refers to strategies or techniques researchers use to ensure the validity and reliability of the research process and its findings (Sargeant, 2012). According to Taherdoost (2016), validity refers to the extent to which the outcome of a study accurately captures the reality of the subject or phenomenon being studied, while reliability refers to the consistency of the research output, that is, the research is repeatable. According to Mertens and Hesse-Biber (2013), credibility in the research context refers to the extent to which the research findings can be trusted or simply the trustworthiness of the research findings. To ensure the reliability, validity, and credibility of this study, the following strategies or techniques were used:

3.10.1 Content Validity

Content validity measures how well a research instrument can capture the required information it aims to capture (Trompenaars et al, 2005). This study used subject matter experts to validate the content of the questionnaire and the semi-structured interview questions. The use of subject matter experts to validate the content of questionnaires is widely used in social science as a strategy to improve the validity of the research findings (O'Neill et al, 2009).

3.10.2 Respondent Validation

Respondent validation, also called member checking, is a technique mostly used in qualitative research to explore the credibility of results (Birt et al., 2016). In respondent validations, individuals who participated in the study were given the data or results of the study and asked to check for accuracy and validity (Birt et al., 2016). A summary of the interview was provided to the interviewee to confirm if it is a true reflection of the meetings that occurred. This is a form of respondent validation.

3.11 Ethical Considerations

The study considered the following ethical considerations:

- Ethical approval has been obtained from the University of the Witwatersrand ethical clearance committee. The ethical clearance certificate is attached under Appendix A
- Approval from the relevant competent individual from the Department of Home Affairs to conduct the research has been granted. A letter indicating approval is attached under Appendix C.
- A signed written consent by the interviewee was obtained using Appendix D before the interviews were conducted.
- All personal information that can be used to identify the interviewee was removed during the conversion from audio to text. Appendix F indicates the transcription template used for this study.

3.12 Chapter Summary

This chapter provides a detailed information regarding the methodology and data analysis approach that was followed for this specific study. The chapter also highlights other key aspects associated with methodology, such as sample size, sample methodology and data collection instrument used. The chapter also provides some insights as to how the TOE framework was incorporated into the methodology and data analysis process.

The next chapters are aimed at presenting the results that have been obtained by following the methodology and data analysis approach articulated in chapter 3.

CHAPTER 4: RESEARCH RESULTS

4.1 Introduction

In this chapter, the results obtained following the methodology and approach that was stated in the previous chapter 3 are presented. NVivo 14 software was used to analyse the data and the results are presented in a manner that follows the TOE framework.

4.2 Demographic Data

The total number of participants in the study was 12. The participants were Department of Home Affairs senior management personnel working in units associated with or linked to ICT development or management. Due to privacy concerns, the demographic data is presented in an aggregated or grouped manner. Gray and Citron (2013) proposed numerous approaches that can be used to aggregate data to protect participants' privacy, and, in this study, the following aggregation is considered when presenting the data:

- Gender of participants is not included as the staff numbers are skewed towards males at the target level.
- The qualification specialisation is not included. Only the qualification level is provided.
- The years of experience and number of years with the Department are given as a range rather than individual values.
- A unique participation ID code replaces any information that can be used to identify the participant.

Most of the participants interviewed are experienced professionals with an average of over 10 years of ICT experience, and most of them have also been with the Department for a significant time, ranging between 5 to 10 years. In terms of qualification, most possess a University Degree or BTech equivalent as their highest qualification with few only having an honours degree. Table 3 below, provides details of the demographics of the participants.

Interviewee ID	Highest qualification	No Years in the ICT sector	No of years with the Department
Int1	Honours Degree	11-15	6-10
Int2	Degree	16+	6-10
Int3	Honours Degree	16+	6-10
Int4	Degree	11-15	6-10
Int5	Diploma	11-15	11-15
Int6	Honours Degree	6-10	0-5
Int7	B. Tech Degree	16+	11-15
Int8	B. Tech Degree	11-15	0-5
Int9	B. Tech Degree	16+	16+
Int10	Honours Degree	16+	6-10
Int11	B. Tech Degree	11-15	6-10
Int12	B. Tech Degree	11-15	6-10

Table 3: Study participant demographic information

4.3 Knowledge of technology adoption

Technology adoption is defined as the process by which new technology is accepted, integrated, and ultimately utilised either by people or organisations (Carr Jr,1999). Numerous academics have developed different frameworks and models to explain the process and factors that influence people and organisation to adopt and use new technologies. It is expected that since the participants in the study are experienced ICT professionals, they would have some knowledge regarding technology adoption process and the different frameworks or methodologies that exist to model or explain the process. The following question was posed to the participants during the interview:

“What is technology adoption, and do you know have any technology adoption frameworks?”

Out of 12 participants only 1 (8.33%) participant, participant Int5 was able to provide an appropriate definition of technology adoption and name an example of technology

adoption framework TAM. Most of the participants referred to The Open Group Architecture Framework (TOGAF) as a technology adoption framework. According to Kotusev (2018), TOGAF is a high-level methodology that is for enterprise-wide software development. Thus, it does not qualify as a technology adoption methodology.

4.4 Technology Organization Environment Elements

The study intends to evaluate the adoption of 4IR technologies in the Department using the TOE framework. The semi-structured interview questions were modelled to reflect the framework, and specific key sub-elements within the TOE framework. The interview transcriptions were uploaded to NVivo 14 and coded according to the framework. Figure 3 shows the number of themes coded in each transcription.

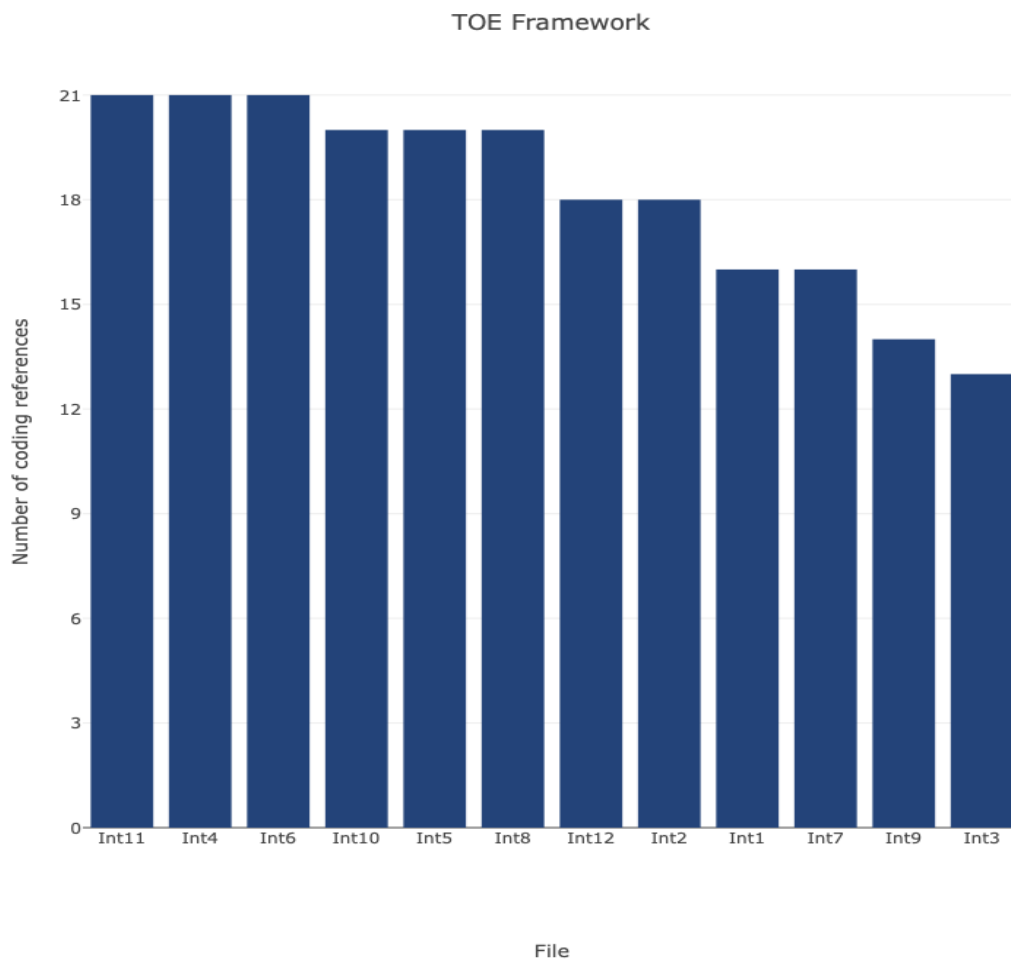


Figure 3: Graph of the number of coding references per participant

Participants Int11, Int4, and Int6 provided significant relevant information for this study; hence, their transcription had the highest number of coding references; participant Int3 provided the least relevant information for this study.

4.4.1 Technology Perspective of TOE Framework

In this study, 3 sub-elements, namely Technology characteristics, perceived benefit, and perceived risks, which are aligned with the technology perspective, are evaluated. Multiple questions were posed to participants under each sub-element and are discussed in the following section.

4.4.1.1 Technology Characteristics

The Participants were asked three questions to gain information regarding the type of 4IR technology being used in the Department and the complexity and compatibility of the technology. Complexity is defined as the perceived relative difficulty in using or implementing technology, while compatibility refers to the perceived consistency/similarity or ease of integration of new technology when compared to the existing technology (Mndzebele, 2013). According to Posey and Bari (2009), the complexity and incompatibility of technology hinder the adoption of new technology by people or organisations.

Participants were asked the following question to identify the types of 4IR technologies being used by the Department of Home Affairs:

“What 4IR technologies are currently being used by the Department of Home Affairs?”

A total of 9 (75%) participants' responses were considered significant or appropriate for the study and coded appropriately. The coded data was then reviewed and grouped into themes. Table 4 provides a summary of 4IR Technology used within the Department.

Table 4: Types of 4IR technologies used within the Department of Home Affairs

Technology type	Number of references
3D Printing	1
Analytics	1
Biometrics	4
Cloud Computing	3
Digitisation	1

To determine the perceived complexity of the identified 4IR technology. They were asked the following questions:

How complex are these technologies?

Out of 12 participants, 8 (66.66%) participants indicated that the technology is extremely complex. This is highlighted by participants Int5 and Int8, who indicated the following:

“I would say from perspective, the technology is very complex, especially because the Department has multiple systems old and new which need to be integrated to perform a specific function” – Int5

“The technology is very complex because that's why there's there are continual delays in terms of implementing these projects” – Int8

To determine the perceived compatibility of the identified 4IR technology with the existing legacy system. They were asked the following questions:

“Are these technologies compatible with the Department's legacy systems?”

A total of 7 (58.33%) out of 12 participants indicated that the technology is incompatible with legacy systems. Participant Int7 emphasised this fact when they said:

“The new technology is not compatible with the old technology to a point where they had to build what I call a broker in between the two systems.” – Int7

Participants Int5 and Int12 indicated the technology is compatible and provided the rationale supporting their answer,

“I can say yes, because the technologies are working, and they are working with the help of an integration platform between new systems and the legacy systems. There are challenges there and there in terms of implementation.” – Int5

“Yes, it's compatible because with our legacy systems, if we want to integrate with another system, we use the middlemen to lay relate the message between the two systems.” – Int12

4.4.1.2 Perceived Benefits

The participants were asked 2 questions to understand the perceived benefits of using 4IR technology and how adoption of the technology will assist with Department mandate and improve service delivery. The third question aimed to determine if the Department has mechanisms in place to determine the impact of technology on general productivity and service delivery.

The perceived benefits that can be derived from using or implementing new technology are regarded as key drivers that can influence the adoption of new technology by either individuals or organisations (Nanggong, 2019). The research postulates that having mechanisms in place to monitor the impact of technology on performance and productivity ensures that one has a firm understanding of the benefits associated with using new or old technology.

The following question was posed to participants to determine the perceived benefits of adopting 4IR technology.

“What are the benefits of adopting 4IR technologies for the Department of Home Affairs?”

The participants of the study all agree that there are significant benefits that the Department can derive from the adoption of 4IR technology. This is highlighted by participants Int10 and Int11 who stated the following:

“The one obvious benefit is quick turnaround times and improved service delivery.” – Int10

“It would mean less corruption, less queues and less human error.” – Int11

The responses from the participants were coded and then grouped into themes, which are summarised in Table 5 below.

Table 5: Perceived benefits of using 4IR Technology

Perceived Benefit	Number of references
Improved service delivery	7
Less Human Error	2
Reduced corruption	3

The following question was posed to participants to determine how adopting this 4IR technology could assist the Department in achieving its mandate and improving service delivery.

“How will these technologies help the Department achieve its mandate and improve service delivery?”

The responses from the participants were coded and then grouped into themes, which are summarised in Table 6 below.

Table 6: The impact of technology on Department mandate and service delivery

Impact on mandate & services delivery	Number of references
Improved service delivery	5
Less Human Error	3
Reduced corruption	2
Improved security	1
Better Integration with key stakeholders	1

Participants were asked the following questions to determine whether DHA has a mechanism in place to monitor the impact of technology on productivity.

“Is there a mechanism the Department uses to measure the impact of technology on employee productivity or service delivery?”

A total of 8 (66.66%) out of the 12 participants indicated that the Department does not have any mechanisms to monitor technology's impact on employee productivity or service delivery. The 4 (33.33%) participants who indicated that the Department has mechanisms in place to monitor the impact of technology on productivity and service delivery all shared the same or similar sentiment with participant Int9 who indicated the following:

“Yes, even though it's not direct, for instance, the branches have APP targets linked to the different products the Department offers ID, passports, etc those products and APPs cannot be achieved if the system is not available” – Int9

4.4.1.3 Perceived Risk

According to Nanggong (2019), technology perceived as risky or possessing a level of risk that is difficult to mitigate is likely to hinder its adoption. Participants were asked two questions about the perceived risk associated with adopting 4IR technology. The objective of the question was to identify the risk and, secondly, determine if the participants believe that the Department has sufficient capacity to manage or mitigate the risk.

The following question was posed to participants to identify the perceived risk type associated with adopting 4IR technology:

“What are the perceived risks of adopting 4IR technologies for the Department of Home Affairs?”

The responses from the participants were coded and then grouped into themes, which are summarised in Table 7 below.

Table 7: The perceived risk associated with 4IR technology

Risk type	Number of references
Cyber attack	5
Data Security	3
Job Loss	4
State Information Technology Agency (SITA) Capacity	1
Skills Capacity	2

Participants were asked the following questions to determine whether DHA can manage the risk associated with the adoption of 4IR technology:

“Does the Department have the capacity to manage the risk, and how would the Department manage the risk?”

A total of 9 (75%) out of 12 participants indicated that the Department could manage the risk associated with adopting 4IR technology. The three participants who are of the view that the Department does not have sufficient capacity to manage the risk share the same sentiment or viewpoints with that of participants Int10, who said the following:

“The risk unit, in my view it's not capacitated enough when you compare the number of risks that we have. So as much as we have experts who try and deal with and monitor all the risks, they are not enough or resourced appropriately. So, I wouldn't think that we are capable of managing the risk.” – Int10

To summarise and visualise the information related to the technology perspective a word cloud was created focusing on all the coded content in the technology perspective. The word cloud is illustrated in Figure 4:

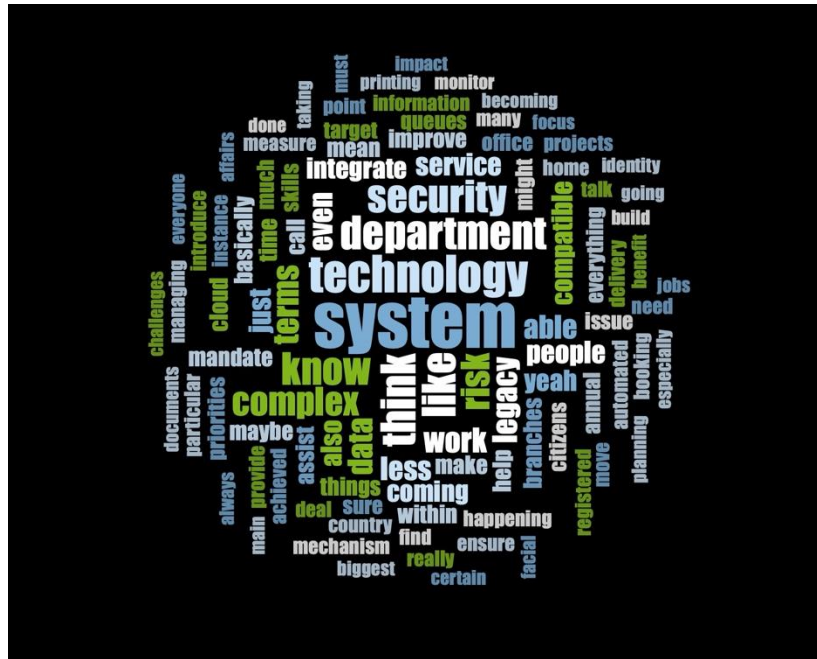


Figure 4: Technology perspective word cloud

4.4.2 Organisation Perspective of TOE Framework

In this study 3, sub-elements, namely organisation characteristics, Leadership support, and employee skills, which are aligned with the organisation perspective, are evaluated. Multiple questions were posed to participants under each sub-element and are discussed in the following section.

4.4.2.1 Organisation characteristic

The following key elements relating to organisational characteristics are evaluated: organisational culture relating to new technology, the organisation's openness to change in the way it operates, and the capacity of the Department to manage the change.

Organisational culture relating to new technology refers to employees' attitudes and behaviour towards implementing or using new technology. According to Singaram (2021), organisations that value innovation and have a digital mindset are more likely to embrace and adopt new technology. The organisation's willingness to change the way it operates

has the potential to hinder the adoption of new technology that might have a disruptive effect on the way of working (Burgess & Connell, 2020). The organisation's capacity to manage change increases the likelihood of it adopting and deploying new technologies. The adoption process of new technology is perceived to be low risk in terms of potential of interrupting operational capacity and efficiency of the organisation.

To determine the organisational culture regarding the adoption of new technology, the participants were asked the following questions:

“What is the Department of Home Affairs' culture around the adoption of new technologies?”

A total of 7 (58.33%) out of the 12 participants indicated that the Department culture does not support the use of new technologies. Participant Int11 succinctly articulated the shared view of the participants that believe that the Department does not have a pro-new technology culture when they said

“When we introduce new technologies, the employees, I guess they don't want to use it. They're comfortable with the old systems and they will find anything and everything wrong with the new system so that they don't use it, any easy excuse. and they rushed to go back to the old systems” – Int11

The following question was posed to participants to determine if the organisation is open to changing the way operates.

“How open is the Department to changing the way they operate or function?”

Out of the 12 participants, 8 (66.66%) indicated that the organisation is open to change, however, Participants' Int12 provides a compelling argument that is opposed to most of the participant's viewpoints.

“An organization is defined by its people, the fact that majority of its staff are anti-technology means the organization is not open to change and to embracing the Fourth Industrial Revolution.” – Int12

To determine If the Department can manage the potentially disruptive nature of 4IR technology, the participants were asked the following questions:

“Do you think the Department can manage change associated with adopting new technology?”

A total of 9 (75%) participants indicated that the Department could manage the change that could potentially arise through the adoption of new technology. Participant Int12 succinctly captures the view of most participants who believe so, while Participant Int10 captures the views of the minority.

“We have a change management unit that deals with those changes that would be required.” – Int12

“I don't think we are capable of managing change the way it should, you know, because if we were first, we would be taking the directorate responsible for change management seriously and making sure that they capacitated properly. It's easier to say this requires change management, but are you supporting that change management unit to be able to function fully?” – Int10

4.4.2.2 Leadership Support

Participants were asked three questions to understand the perceived support from leadership within the Department of Home Affairs. The questions targeted understanding the propensity of DHA leadership to support the adoption of new technology, to invest in new 4IR technology, and whether the Department has a 4IR vision that leadership supports. Van Dun and Kumar (2023) state that leadership within an organisation plays a crucial role in the adoption of new technology by providing strategic leadership and support.

The following question was posed to the participants to determine if the Department leadership supports the adoption of 4IR technology:

“Does the leadership of the Department of Home Affairs support 4IR adoption?”

Out of 12 participants, 10 (83.33%) indicated that the Department of Home Affairs supports the adoption of 4IR technology. Participant Int10 summarized the views of participants that believe the leadership supports the adoption of new technologies while Participant Int4 summaries the opposing views.

“I would say yes, the leadership does support the Four IR to a point whereby I think they are too eager, they can't wait to get there. So maybe if they can just slow down and understand that Rome was not building one day, then I believe that would achieve so much more” – Int10

“They are more focused on service delivery at the level of just making sure that the people get what they need. So, we're still covering fires instead of looking into new ways of innovation” – Int4

Participants were asked the following question were asked the following questions to determine if the Department has a 4iR vision or strategy and if leadership in the Department supports that document:

“Does the Department have a 4IR vision, and are the Department's leaders committed to the 4IR vision?”

A total of 9 (75%) participants indicated that they have no knowledge or existence of a 4IR strategy or vision for the Department. These views of the participants that believe so are better articulated by participant Int2, who said the following:

“There's no clear written strategy where the leaders can communicate their thinking and help other people see the same vision as well.” – Int2

The following question was posed to the participants to determine the willingness of leadership within the Department to invest in 4IR technology.

“Are the Department's leaders willing to invest in 4IR initiatives?”

All the participants participating in the study indicated that the Department of Home Affairs leadership is willing to invest in new technology. This fact is better articulated by Participant Int12 when they said

“I think they do as they like put a lot of budgets towards technology.” – Int12

4.4.2.3 Employee Skills

Abe *et al* (2021) argue that the employee skills capacity and the ability to either up-skill or acquire new skills has co either hindered or promoted the use of new emerging technologies. To evaluate the skill capacity of the Department, two questions were posed to the participants. The first question was aimed at understanding if the participants feel the Department has the required capacity, and the second question was targeted at determining if the Department has an upskilling strategy or plan for its employees.

The participants were asked the following questions to determine the perceived skills capacity of the Department to implement use and manage 4IR technology:

Do you think that Department employees have the skills necessary to adopt and operate 4IR technologies?

A total of 7 (58.33%) participants indicated that the Department does not have the skills necessary to adopt and operate new technologies. These views are clearly articulated by Participant Int10 and Participant Int4.

“No, I don’t think so. A point whereby I know that currently in the IS environment, they are busy doing a skills audit for all its employees because for some reason back in the days when I don’t know, maybe it’s when the ANC took over, people were getting employment

not because of the qualifications that they possess, but because maybe of who they knew at that time” – Int10

“No, they don’t because skill management is not transparent so they don’t fully look at the resources and what skills do they have to see where they can improve. Loosely meaning they don’t know which skills they have and don’t have in the Department” – Int4

The following question was posed to the participants regarding the existence of a plan or strategy to upskill and reskill its employees to be able to manage the new emerging technologies.

“Does the Department have a plan or strategy that focuses on upskilling staff to ensure that they are capable of managing new emerging technologies?”

A total of 9 (58.33%) participants indicated that the Department has a plan or strategy in place to upskill or reskill its employees. These views are better highlighted by Participant Int8 and Participant Int7

“Yes, there is a strategy around that, and it is driven from via the learning Academy” – Int8

“The Department does have the learning academy, which is a platform used for training by employees, the only issue is that it only focuses on training regarding new systems” – Int7

To summarise and visualise the content contained in the organisation perspective a word cloud was created focusing on all the coded content from the organisation perspective. The word cloud is illustrated in Figure 5:

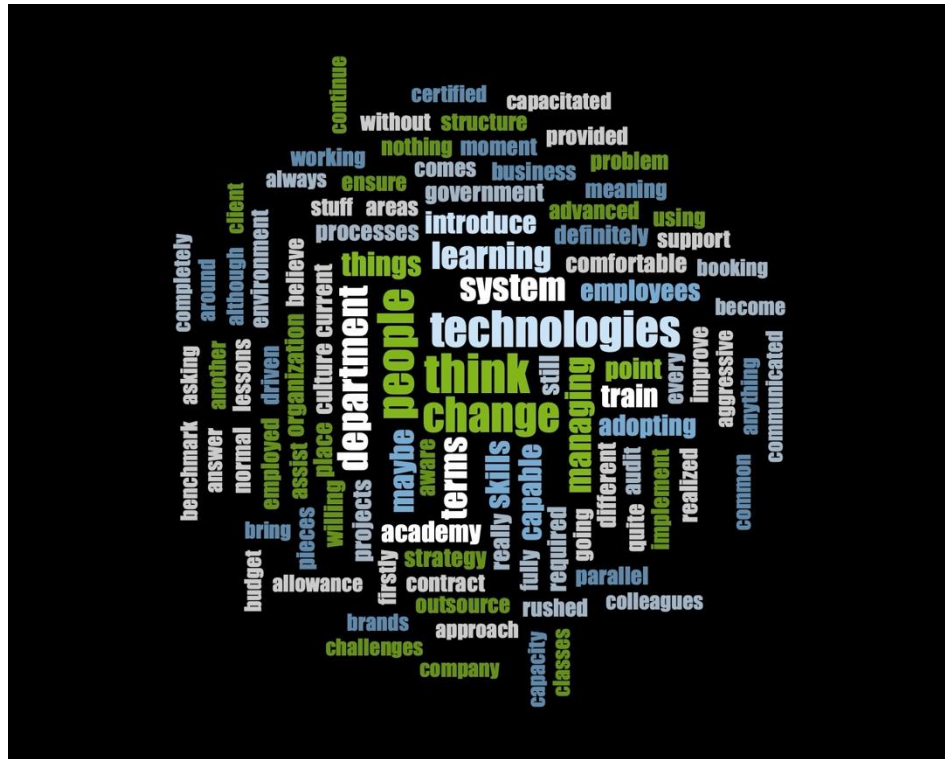


Figure 5: Organization perspective word cloud

4.4.3 Environment Perspective of TOE Framework

In this study 3, sub-elements, regulatory environment, competitive pressure, and customer expectation, which are aligned with the external environment perspective, are evaluated. Multiple questions were posed to participants under each sub-element and are discussed in the following section.

4.4.3.1 Regulation environment

The following key elements relate to the regulation environment that governs the implementation and adoption of new technologies by the Department. Participants are asked questions that are aimed at determining their knowledge regarding legislation that has a direct impact on the adoption of new technologies and the compliance capacity of the Department regarding the identified legislation.

An explicitly strict regulatory environment can hinder the adoption of new technologies by placing unnecessary restrictive requirements on the implementation of new technologies which might make new adoption of the technologies not attractive or desirable.

The participants in the study were asked the following question to determine if they were knowledgeable about the existence of the regulation that governs the adoption of new technology:

“Are you aware of know of the regulatory requirements for the adoption of 4IR technologies by a government Department?”

A total of 7 (58.33%) participants indicated that they do not have any knowledge or information regarding the regulatory requirements that exist that govern the deployment of new technologies within the Department as articulated by participant Int8.

“I feel like maybe this is a thing that governance will look into like you find that maybe even the policy might need to change and align with that adoption and all that. But and for now, I don't know any regulations” – Int8

The following question was asked to participate on where the Department can comply with set regulations regarding the deployment of technology within the Department:

“Does the Department comply with these regulations?”

All the participants who indicated that they know regulations that need to be complied with regarding the deployment of new technology unanimously agreed that the Department can comply with all the current regulations.

4.4.3.2 Competitive pressure

Competitive pressure in the context of this study refers to pressure exerted on the Department by external parties or entities. The researcher postulates that sufficient positive pressure from external stakeholders would encourage the Department to adopt 4ir technology. Two questions were posed to the participants aimed at determining if there is external pressure and if it exists, from where it is coming from.

The participants in the study were asked the following question to determine if there is external pressure from stakeholders that is pressuring the Department to adopt 4IR technologies.

“Do you believe there is pressure on the Government to advance and start using 4IR Technologies?”

A total of 10 (83.33%) participants indicated that there was pressure from external stakeholders for the Department to start implementing 4IR Technologies. A follow-up question was posed to these participants on where the pressure originates from. The participants' response was coded and grouped into themes which are summarised in Table 8 below.

Table 8: The origin of external pressure on the Department to adopt 4IR Technology

Origin of pressure	Number of references
General Public	2
Government	3
Other Countries	2
Private Sector	3
Technology	2

4.4.3.3 Customer Expectations

Heidenreich and Handrich (2015) have argued that an organisation's or business's customers are crucial in determining the type of technology it deploys. Organisations that can deploy technologies that can meet the needs and expectations of their customers have a competitive advantage in terms of market reach (Heidenreich & Handrich, 2015). In this study, participants were asked two questions aimed at understanding what the expectation from its customers is and how are they currently trying to meet those expectations.

The participants in the study were asked the following question aimed at understanding the Department's customer expectations

“What is the customer's (citizens and foreign nationals) expectations for 4IR technologies in the government sector?”

Table 9: Customer expectation in terms of technology in the government sector

Customer Expectation	Number of references
High availability	6
Secure platform	3
Real-time tracking	2
Easy to use	1

A follow-up question was posed to the participants aimed at understanding if the Department can meet the customer expectations or has a mechanism in place to do so. A total of 7(58.33%) participants indicated that the Department could meet the customer expectations. These views are better articulated by Participant Int6 and Participant Int5:

“We try to meet those expectations with the introduction of this new technology such as the booking system which is aimed at reducing lines and foot traffic at the branches. Thus, our customers don't spend the whole day there to get service.” – Int6

“The new smart ID & passport systems are a great example of this, people no longer require bringing a picture when making an application, and the turnaround time for receiving the documents is faster. And its all thanks to the new technology that the Department has introduced” – Int5

To summarise the content contained in the environment perspective a word cloud was created focusing on all the coded content in the environment perspective. The word cloud is illustrated in Figure 6:



Figure 6: Organization perspective word cloud

4.5 Chapter Summary

This chapter presents the results obtained by following the methodology and data analysis approach adopted for this specific study as articulated in the chapter3. The data analysis was conducted using NVivo 14, and the results are presented in a manner that clearly shows how the TOE framework was embedded in the methodology and analysis process for this specific study.

The next chapter will discuss the findings or results of this study in the context of aim and objectives.

CHAPTER 5: RESULTS DISCUSSION

5.1 Introduction

The objective of this chapter is to present the discussion of the results presented in Chapter 4 in the context of the study's objective. Other relevant information that was highlighted and deemed relevant for the study is discussed further in this chapter.

5.2 Study Objective

The study aimed to evaluate the adoption of the Fourth Industrial Revolution (4IR) technology by the Department of Home Affairs, focusing on understanding the status, identifying challenges and benefits, and providing recommendations for effective implementation. The Evaluation of the adoption of 4IR technology was to be modelled on the Technology Organisation Environment framework developed by Tornatzky and Fleischer (1990). To ensure that the aim was achieved the following objectives for this study were set:

- To identify the type of 4IR technology currently being used by the Department of Home Affairs.
- To assess the general knowledge regarding technology adoption methodologies or framework
- To examine the perceived impact of 4IR technologies on DHA's overall operations and service delivery.
- To identify the key factors influencing the adoption of 4IR technology by the DHA

The results obtained in this study revealed the following insight in line with the set study objective:

5.2.1 To identify the type of 4IR technology currently being used by the Department of Home Affairs.

The study revealed that biometrics and cloud computing are the two key technologies that the Department is focusing on, although the participants indicated that more progress had been made in terms of biometric technology implementation in the form of fingerprint identification, facial recognition, and that the Department is currently working on iris recognition as opposed to cloud computing. The deployment of cloud technology has been delayed largely due to data security issues and capacity challenges experienced by State Information Technology Agency (SITA), which has the mandate to provide the Department's private or government cloud platform.

The fact that none of the participants mentioned blockchain technology, which has applications in identity management, specifically in ensuring a high level of digital identity security, is of concern. This may serve as an indication that the participants are not exposed to other 4IR technologies apart from the ones that are currently in implementation or planning.

5.2.2 To assess the general knowledge regarding technology adoption methodologies or framework.

The findings revealed that participants had extremely limited knowledge regarding the different technology adoption methods or frameworks, as only 1 participant could provide a correct answer. Most of the participants stated that TOGAF was a technology adoption framework. The lack of knowledge or awareness of the technology adoption framework leads to a narrow technical focus on technology deployment, which often does not yield the desired outcomes (Varajão *et al*, 2022). This can lead to system underutilisation or hinder technology uptake by target end users (Varajão *et al.*, 2022).

5.2.3 To examine the perceived impact of 4IR technologies on DHA's overall operations and service delivery.

The findings revealed that the deployment of 4IR technologies would have a positive impact on the overall operation and improve service delivery. The two key areas in which technology positively impacts service delivery are automatic tasks and reducing human error. The other area relates to the reduction of corruption activity relating to issuing Identity documents to the wrong people.

Many participants also indicated that deploying this new technology would likely result in job losses, as a significant portion of the Department's work process is still manual. Furthermore, the participants stated that this is the major reason many employees are against deploying new technology as it threatens their job security. This finding supports the study conducted by Tarafdar et al. (2007) in which they articulate the stress created by new technology and how people often react to the use of new technologies in a working environment.

5.2.4 To identify the key factors influencing the adoption of 4IR technology by the DHA

Numerous factors influencing the adoption of 4IR technology within the Department of DHA were identified. Table 10 below provides a summary of the factors influencing technology adoption based on the TOE framework. Each factor that is identified to be influencing 4IR technology adoption is either labelled as promoting adoption, hindering adoption, or neutral based on the reflection of the results.

Table 10: Summary of the factors influencing technology adoption in DHA

TOE Framework	Sub element	Factor	Type of Influence
Technology	Technology Characteristic	Technology Type	Neutral
		Complexity	Hindering Adoption
		Compatibility	Hindering Adoption
	Perceived Benefit	Benefits to DHA	Promoting Adoption
		Impact on DHA Mandate and Services Delivery	Promoting Adoption
		Monitoring the Impact of Technology on productivity and service Delivery	Hindering Adoption
	Perceived Risk	Type of risk	Neutral
		Risk Management Capacity	Hindering Adoption
Organisation	Organisation Characteristic	Attitude towards technology	Hindering Adoption
		Open To change	Hindering Adoption
		Manage Change	Hindering Adoption
	Leadership Support	Support New Technology	Promoting Adoption
		Invest in New Technology	Promoting Adoption
		Develop a 4IR vision and support it.	Hindering Adoption
	Employee Skills	Current Skill Capacity	Hindering Adoption
		Upskilling Plan	Hindering Adoption
Environment	Competitive Pressure	External Pressure to adopt new technology	Promoting Adoption
	Customer Expectation	Customer Expectation	Promoting Adoption
	Regulatory Environment	Knowledge of regulation	Hindering Adoption
		Compliance to regulation	Hindering Adoption

It is, however, worth noting that all the factors that are hindering the adoption of new technologies within the Department of DHA are in one way, or another linked to its employees, either their attitude, knowledge, skill level and capacity to carry out their duties. The main challenge hindering technology adoption at DHA is internal and employee centred.

5.3 Other insights from the result

The following sections are a summary of the data and the results that are worth noting as they might influence the study outcomes or interpretation of the data:

5.3.1 DHA Learning Academy

Upskilling or reskilling is a process where one acquires knowledge and skills that have a market value (Li, 2022). DHA Learning Academy is a platform where internal staff are trained on new technology that the Department is in the process of implementing. This cannot be interpreted as upskilling or reskilling of employees because the platform is developed as part of the change management initiatives within the Department.

5.3.2 Internal Capacity Challenge

The interviews indicated that the Department of Home Affairs could have serious capacity challenges in terms of human resources and skills, specifically in the information system sector. Without the right human resources, any plans or projects relating to large-scale technology deployment are likely to be delayed or might not necessarily be able to address their set objectives since there are not enough or appropriate skilled individuals managing the projects.

5.3.2 The Role and Capacity of SITA.

The State Information Technology Agency (SITA) is a state-owned entity created to provide information technology services to all Government Departments. SITA's objective is to provide the state and its government entities with secure, integrated, and cost-effective ICT services. Participants have indicated that SITA is unable to provide the

Department with appropriate ICT services such as broadband. Stating that when the Department is offline it is not always their fault but SITA's. The migration to the cloud and development of government cloud is another element that SITA leads on behalf of the government; hence, there is a delay in the use of cloud technology by the Department.

5.3.3 Parallel System Deployment Strategy

Participants indicated that the Department normally employs a parallel system deployment strategy where legacy systems act as a backup for the new systems. Participant Int11 stated the following:

"We normally use a parallel deployment strategy where a legacy system acts as a backup for new systems. The problem that I have noticed is that once we encounter a small issue with the new system, we automatically revert to the old system, and it might take weeks and, in some cases, months before we go back again to the new system. I think this is the reason why projects are often delayed with the Department" – Int11

Based on the findings, the parallel deployment strategy does not enable users to fully explore a technology and learn how to troubleshoot it. This approach is hindering the adoption of new technologies within the Department.

5.3.4 Client facing vs back-office investment.

The investment into new technologies within the Department is skewed toward client facing technology rather than back-office staff related technology. Back-office refers to all the digital platforms that the Department uses for its daily operation of staff-related matters, while client-facing refers to all the digital platforms or tools that are developed solely to assist the Department's external clients. Two participants, Int 6 and Participant Int11 indicated that although the Department is perceived to be advancing technology, most of these technologies are client facing. They both indicated that a simple task like applying for leave is currently still being done by manual paper. This skewed investment can potentially negatively impact staff attitude towards the deployment of new client facing technologies.

5.4 Chapter Summary

This chapter presented the results interpretation in the context of the study's aim and objectives. The study showed that the key factors that have a negative impact on the adoption of new technology by the Department are its employee attitude from the organisation's perspective and the external environment perspective, its SITA's role and capacity as it relates to the provision of government ICT for national and provincial Departments. Other key insights observed but not necessarily part of the study is also presented.

The next chapters focus on the conclusion and recommendations of the study.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter aims to provide an overall summary of the findings and recommendations on how the Department of Home Affairs can improve future technology implementation. Recommendations for future studies will also be proposed.

6.2 Conclusion

This study aimed to evaluate the adoption of 4IR technology by DHA using a TOE framework. The findings indicated that despite leadership support of new technology and increased investment in new technology in the Department, the Department is lagging in terms of new technology. This is attributed to employee attitude towards new technology, their skill capacity, and resources capacity to conduct there are major hindrances toward adopting new technology from an internal perspective.

Externally, SITA's capacity to deliver the required services is seen as a major external factor with significant potential to hinder the Department's adoption of new technology. Failure of DHA leadership to address the staff capacity issues would likely lead to low or delayed adoption of new technologies that could positively impact the Department in terms of service delivery or mandate.

6.3 Recommendation

This study proposes that the Department should implement the following recommendations to ensure that they can achieve full technology adoption within the Department in the future:

- The Department should develop a holistic 4IR long-term strategy that looks at both client-facing and back-office technologies. The objective of developing a long-term strategy is to ensure that the deployment of new technology is not

just targeted at current quick wins but is forward-facing so that the Department's technology becomes future-proof.

- To develop and invest in the upskilling and reskilling of all its staff. This will ensure that the Department has the necessary skills to implement, manage, and support the new technology. Furthermore, employees who lack the proper ICT skills can upgrade their skill set.
- It is recommended that the Department develops and implements an organisation-wide, long-term communication strategy. The communication strategy aims to ensure that all staff are aware of the organisation's strategic vision regarding technology and how it would likely affect them. The employees will also be informed of the upskilling and reskilling opportunities available that would be able to prepare them for the upcoming changes. The aim is to transform the organisation from being anti-new technology to being pro-new technology.
- The Department of Home Affairs should lobby the national government about the performance of SITA. The lobbying aimed to raise awareness of SITA's impact in terms of hindering the country's 4IR ambitions and ultimately pressure the entity to improve its performance.

6.4 Future Research

In addition to the current study, several research avenues could complement and enrich its findings:

- **Evaluating the Adoption of Fourth Industrial Revolution (4IR) Technologies within Government Departments:** This research will delve into the extent to which various government departments have embraced 4IR technologies and identify common factors influencing adoption across different governmental sectors. It could involve examining factors such as budget allocation, leadership support, organizational culture, and technological infrastructure.

- **Analysing the Role of the South African Government's ICT Governance and Policy:** This study will focus on understanding how governmental ICT governance structures and policies influence the adoption and integration of new technologies. It would explore the effectiveness of existing policies in fostering technological innovation and digital transformation within government agencies and departments.
- **Developing an Impact Assessment Framework/Tool for New Technology Implementation:** This research endeavour aims to create a comprehensive framework or tool to assess the impact of implementing new technologies on various organizational factors. It would analyse how the introduction of 4IR technologies affects factors such as productivity, service delivery efficiency, user satisfaction, and overall organizational performance.
- **Assessing General Public Readiness for 4IR Technology Utilization:** This study would investigate the readiness of the general public in South Africa to embrace and utilize 4IR technologies. It would assess factors such as digital literacy levels, access to technology and internet connectivity, availability of training and educational resources, and overall receptiveness to technological advancements among the population.
- **Investigating the Socioeconomic Impact of 4IR Technology Adoption on Unemployment:** This research will explore the implications of widespread adoption of 4IR technologies, particularly automation, on the country's unemployment rate. It would examine how technological advancements in areas such as artificial intelligence, robotics, and automation impact job availability, job distribution across industries, and the overall socioeconomic landscape of South Africa.

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APPENDIX A: ETHICS CLEARANCE CERTIFICATE

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg



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

Ethics Clearance Certificate

Ethics protocol number: WBS/DB1850316/809

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

This certificate is only valid if accompanied by formal permission from the relevant stakeholder(s).

Project title	Evaluating the adoption of Fourth Industrial Revolution related technologies by the Department of Home Affairs.
Investigator / Researcher	Mr Sekie Molobi
Nature of Project	MM (Digital Business)
Decision of the Committee	Approved, provided stakeholders and participants are guaranteed confidentiality.
Issue Date of Certificate	9/11/2023
Expiry date	Date of submission of the project / research report
Chairperson	Dr Pius Oba  +27 11 [REDACTED]  +27 82 [REDACTED]  [REDACTED]@wits.ac.za 

Declaration by Researcher

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

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


Signature

11 September 2023

Date:

APPENDIX B: LETTER REQUESTING PERMISSION TO CONDUCT RESEARCH



The University of the Witwatersrand,
Faculty of Commerce, Law, and Management

Att: Chief Information Officer
Thulani Mavuso
Department Of Home Affairs
Hallmark Building, Johannes Ramokhoase Street, Pretoria Central

31 July 2023

Dear Sir,

Re: Permission to conduct research at the Department of Home Affairs.

My name is Sekie Michael Molobi.

I am studying for a Master of Management in the field of Digital Business at the Faculty of Commerce, Law, and Management at the University of the Witwatersrand. I am seeking permission to do research at the Department of Home Affairs.

I am conducting research on the adoption of Fourth Industrial Revolution (4IR) technologies by the Department of Home Affairs under the guidance of Dr. Kebashnee Moodley.

The purpose of this study is to assess the Department of Home Affairs' implementation of the Fourth Industrial Revolution (4IR) technology. The study aims to understand the current status, identify challenges and benefits, and provide recommendations for the effective implementation of the Fourth Industrial Revolution related technologies.

I will invite individuals from your organisation to participate in this study. The targeted participants include IT staff and senior managers within the Pretoria Hallmark & NCB buildings. If they agree, they will be asked to answer a short questionnaire and be interviewed. The interview duration will not exceed 30 minutes and shall be conducted at DHA premises during working hours. While the interviews will be recorded, the final report will not use any identifiable participant information.

Participants will be asked to give their written consent before the research begins. Their responses will be treated confidentially, and identities (their names) will be

anonymous unless otherwise expressly indicated. Individual privacy will be maintained in all published and written data resulting from the study.

The results will be communicated through the printed dissertation shared with the department.

The research participants will not be advantaged or disadvantaged in any way. They will be reassured that they can withdraw their permission at any time during this project without any penalty. There are no foreseeable risks in participating in this study. The participants will not be paid for this study.

All research data will be securely stored 1 year after the final report submission.

I, therefore, request permission in writing to conduct my research at your organisation. The approval letter should be on your organisation's headed paper, signed, and dated, and specifically referring to me by name and the title of my study.

Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Yours sincerely,



Sekie Michael Molobi (Researcher)

+27 71 [REDACTED]

[REDACTED]@students.wits.ac.za

Supervisor:



Dr. Kebashnee Moodley

[REDACTED]@wits.ac.za

APPENDIX C: LETTER GRANTING APPROVAL TO CONDUCT RESEARCH



home affairs

Department:
Home Affairs
REPUBLIC OF SOUTH AFRICA

DHA-57

230 Johannes Ramokhoase Street, Private Bag X114, Pretoria, 0001
Parliamentary Office, 120 Plein Street, Private Bag X9048, Cape Town, 8000

ENQUIRIES: Karabo Nyezi Tel: 012 [REDACTED] Email: [REDACTED]@dha.gov.za

Sekie Molobi
University of Witwatersrand
JOHANNESBURG
2000

Dear Mr. Sekie Molobi

REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN THE DEPARTMENT TITLED "EVALUATING THE ADOPTION OF FOURTH INDUSTRIAL (4IR) RELATED TECHNOLOGIES BY THE DEPARTMENT OF HOME AFFAIRS"

Your request to conduct research in the Department of Home Affairs "Evaluating the adoption of Fourth Industrial Revolution (4IR) related technologies by the Department of Home Affairs" has reference.

The Department of Home Affairs, through the Research Management unit in the Chief Directorate: Strategy and Institutional Performance, has approved your request to conduct research in the Department. The approval is based on your submission of all the required documents and the value and relevance of your research to the Department.

Furthermore, the approval is **ONLY** for completion of your studies and should you wish to publish any part of your dissertation/thesis, a formal written request should be made to the Department of Home Affairs in writing.

It is our understanding that the research will be conducted using the data collection tool submitted to the Department to ensure that the security of the Department is not compromised.

NB: Upon completion of the study, the Department of Home Affairs requests that you furnish the Research Management unit with a copy of your approved research report for our records.

The Department wishes you all the best in your research study.

Regards

A handwritten signature in black ink, appearing to read 'MR THULANI MAVUSO', enclosed within a hand-drawn oval.

MR THULANI MAVUSO

DEPUTY DIRECTOR-GENERAL: OPERATIONS

DATE: 2/10/2023

APPENDIX C: LETTER TO POTENTIAL RESEARCH PARTICIPANT

Dear recipient,

As a postgraduate student at Wits Business School, I am conducting research on the adoption of Fourth Industrial Revolution (4IR) technologies by the Department of Home Affairs under the guidance of Dr. K Moodley. This research is a part of my master's degree requirements.

The purpose of this study is to assess the Department of Home Affairs' implementation of the Fourth Industrial Revolution (4IR) technology. The study aims to understand the status, identify challenges and benefits, and provide recommendations for effective implementation.

I kindly request that you avail yourself of a 30-minute informal virtual interview to discuss the research topic. Please note the following regarding the interview protocol:

- The interview will mainly be conducted in English
- The interview will be conducted on the Microsoft Teams platform and will be recorded
- Your name or identity will not appear on reports or publications
- The answers you give will be treated as strictly confidential, and will only be used for academic purposes
- At any given point you have the right to terminate the interview process without giving reasons

If you are interested in taking part in the study, please let me know your availability (date/time) and sign and return the consent form that is attached.

In case you have any inquiries or worries, feel free to get in touch with me or my supervisor using the contact details given below.

Thank you very much for your time and cooperation.

Sincerely,
SM Molobi

APPENDIX D: RESEARCH CONSENT FORM

Research Consent form

I _____ have had a thorough discussion with the researcher regarding the study. I am aware that I have the option to withdraw without providing any reasons and I am willingly agreeing to participate in the interview, under the following conditions:

1. The interview will mainly be conducted in English
2. The interview will be conducted on the Microsoft Teams platform and will be recorded
3. Your name or identity will not appear on reports or publications
4. The answers you give will be treated as strictly confidential, and will only be used for academic purposes
5. At any given point, you have the right to terminate the interview process without giving reasons

Signature

Date

APPENDIX E: INTERVIEW QUESTIONS

PART 1

- 1) Please tell me a little bit about yourself about the following:
 - Number of years you have been working for the Department.
 - Qualification
 - Your role at the Department?
- 2) According to you what is technology adoption, and do you know of any technology adoption methodologies or frameworks?

PART 2

Technology

Technological Characteristics

- 1) What 4IR technologies are currently being used by the Department of Home Affairs?
- 2) How complex are these technologies?
- 3) Are these technologies compatible with the Department's legacy systems?

Perceived Benefits

- 1) What are the benefits of adopting 4IR technologies for the Department of Home Affairs?
- 2) How will these technologies help the Department achieve its mandate and improve service delivery?
- 3) Is there a mechanism the Department uses to measure the impact of technology on employee productivity or service delivery?

Perceived Risks

- 1) What are the perceived risks of adopting 4IR technologies for the Department of Home Affairs?
- 2) Does the Department have the capacity to manage the risk and how would the Department manage the risk?

Organisation

Organisational Characteristics

- 1) What is the Department of Home Affairs' culture around adoption technology of new technologies?
- 2) How open is the Department to change the way they operate or function?
- 3) Do you think the Department can manage change associated with adopting new technology?

Leadership Support

- 1) Does leadership support of the Department of Home Affairs support 4IR adoption?
- 2) Does the Department have a 4IR vision, and are the Department's leaders committed to the 4IR vision?
- 3) Are the Department's leaders willing to invest in 4IR initiatives?

Employee Skills

- 1) Do you think that Department employees have the skills necessary to adopt and operate 4IR technologies?
- 2) Does the Department have a plan or strategy that focuses on upskilling staff to ensure that they can manage new emerging technologies?

Environment

Regulatory Environment

- 1) Are you aware of know of the regulatory requirements for the adoption of 4IR technologies by a government Department?
- 2) Does the Department comply with these regulations?

Competitive Pressures

- 1) Do you believe there is pressure on the Government to advance and start using 4IR Technologies?
- 2) From where is this pressure coming from?

Customer Expectations

- 1) What is the customer's (citizens, and foreign nationals) expectations for 4IR technologies in the government sector?
- 2) What is the Department doing to meet these expectations?

APPENDIX F: INTERVIEW TRANSLATION TEMPLATE

Date of Interview	
Participant ID	Int"xx"
Interview Length	
Researcher	<i>Introduction, explanation of research, and research interview protocol. Request participants to consent to be part of the study.</i>
Participant	<i>Gives consent</i>
Researcher	Ask Q1
Participant	Response to Q1
Researcher	Ask Q2
Participant	Response to Q2
Researcher	Ask Q3
Participant	Response to Q3
Researcher	Ask follow up to Q3
Participant	Response to Q3 follow-up question

APPENDIX G: CODEBOOK

Name	Description
Tech Adoption Knowledge	General knowledge of technology adoption
General Knowledge	Defining or explaining what technology adoption is
Correct Definition	Correct definition
incorrect Definition	Incorrect definition
Tech adoption Framework	Knowledge of technology adoption of the framework of methodology
No	Indicate that they don't know
Yes	Indicate that they do know
TOE Framework	The overall framework
Environment	Environment perspective of the TOE framework
Competitive Pressure	Key concept relating to the environmental perspective of TOE being evaluated
External Pressure	External pressure to start using 4IR Technology
No	No external pressure
Yes	External pressure exists
Origin of External Pressure	The origin of the external pressure
General Public	External pressure from the public
Government	External pressure from the government
Other Countries	External pressure from other countries
Private Sector	External pressure from the private sector
Technology	External pressure from the technology we currently using
Customer Expectation	Key concept relating to the environmental perspective of TOE being evaluated
Customer Expectation	Expectations from customers to start using 4IR
Meeting Expectations	Measures in place to meet expectation
Regulatory Environment	Key concept relating to the environmental perspective of TOE being evaluated
Compliance to Regulation	Compliance of the Department with 4IR/technology regulations

Name	Description
Knowledge of Regulation	Knowledge of regulations governing 4IR technology usage by the government
No	The interviewee does not know the regulations
Yes	The interviewee knows the regulations
Organisation	Organisation perspective of the TOE framework
Employee Skills	A key concept relating to the organization perspective of TOE being evaluated
Skill Capacity	Department skill capacity to implement and manage 4IR technologies
No	The Department has no capacity or lacks capacity
Yes	Department has capacity
Upskilling employees	Departments' upskilling strategy or plan
No	The Department does not have a plan or strategy in place
Yes	The Department has a plan and strategy in place
Leadership Support	A key concept relating to the organization perspective of TOE being evaluated
4IR Initiative Investment	Leadership proclivity to invest in new technology
No	Leadership has not shown interest in investing in new technology
Yes	Leadership has shown interest in investing in new technology
4IR Vision	The existence of the 4IR vision for the Department and Leadership support of it
No	No knowledge of a 4ir vision or strategy of the Department
Yes	The existence of a 4ir strategy which is supported by leadership
Leadership Support	Leadership proclivity to support new ICT/4IR initiatives
No	Leadership has shown no interest in supporting new ICT/4IR initiatives
Yes	Leadership has shown interest in supporting new ICT//4IR initiatives
Organisation Characteristics	A key concept relating to the organization perspective of TOE being evaluated
Attitude toward New Tech	The organization's attitude towards new technology (employees)
No	Negative attitude toward the introduction of new technology

Name	Description
Yes	Positive attitude towards the introduction of new technology
Change management	The capacity of the Department to manage internal change
No	The Department cannot manage change
Yes	The Department can manage change
Investment into Tech	The Department's proclivity to invest in technology
No	The Department has shown no interest in investing in new technology
Yes	The Department has shown interest in investing in new technology
Openness to change	The Department's openness to changing the way it operates
No	The Department is open to change
Yes	The Department is not open to change
Technology	Technology perspective of the TOE framework
Perceived Benefits	Key concept relating to the technology perspective of TOE being evaluated
General	Perceived general benefits associated with using 4IR technology
Mandate & Services Delivery	Perceived benefits linked to Department mandate and services delivery
Tech Impact Measure	The existence of a mechanism to measure technology impact on the Department in terms of productivity or service delivery
No	No mechanism in place to measure technology impact
Yes	Mechanisms are in place to measure technology impact
Perceived Risk	Key concept relating to the technology perspective of TOE being evaluated
Risk Management	Risk management strategies of the Department
No	The Department's risk management strategies are not in place or are lacking
Yes	The Department's risk management strategies are in place
Risk Type	Types of risks associated with the implementation of 4IR technology
Cyber Attacks	Cyber-attack risks
Data Security	Data security risks

Name	Description
Job Loss	Job loss risk
SITA Capacity	SITA capacity risk
Skill Capacity	Skills capacity risk
Tech Characteristics	Key concept relating to the technology perspective of TOE being evaluated
Compatibility	Compatibility of 4ir technology with legacy technology/system
No	There is no compatibility or there are compatibility issues
Yes	There is compatibility
Complexity	The complexity of using/implementing 4IR technology
No	4IR technology is not complex to use or implement
Yes	4IR technology is very complex to use or implement
TechType	Type of 4IR technology being used in the Department
3d Printing	3d printing technology
Analytics	Data analytics technology
Biometrics	Biometric technology
Cloud Computing	Cloud computing technology
Digitisation	Digitization technology