AN INFORMATION TECHNOLOGY ARCHITECTURE FRAMEWORK FOR THE IMPLEMENTATION OF THE SOUTH AFRICAN NATIONAL HEALTH INSURANCE

By

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DECLARATION

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

SIGNED **DATE** 18/03/2022

ABSTRACT

Universal Health Coverage (UHC) is an insightful goal from the World Health Organisation. Many governments throughout the world, including South Africa, are adopting the approach. The concept of UHC is premised on the need to ensure that all people access quality healthcare regardless of socio-economic status. The South African NHI is a universal health programme, new in South Africa and meant to achieve the UHC goals. Like every other system, the NHI goals require IT solutions to enable and support its operationalisation and fulfilment. The implementation of NHI requires combining, co-existing, and integration various IT solutions, such as software, hardware platforms, network protocols, and databases, to achieve its goals. The process can be challenging without architectural deployment. A technology architecture governs IT-enabling infrastructures, business processes, designs, and patients' information flow. The deployment of a technical architecture is primarily to prevent prohibitive circumstances, such as loss of data due to lack of security, lack of connectivity, increased procurement and maintenance costs of IT solutions, unreliability, incompatibility and uncertainty of software and hardware, among others.

This study aimed to develop an enterprise technical architecture framework that can guide the implementation of the South African NHI system. Based on the aim, the research objectives were to: - examine the factors (such as process, governance, and legislature) that can influence the implementation of the South African NHI, and examine the technology infrastructures, information exchange, and business (healthcare) requirements for implementing the South African NHI. In achieving the aim of the study, the case study approach was employed and the South African NHI was used as the case. The study adopted a qualitative approach. The qualitative data were collected using the document analysis technique. The Actor-Network Theory (ANT) was employed as a lens to guide the data analysis. The analysis revealed the six factors which influence the implementation of the South African NHI. The factors are readiness assessment, government levels of health services, geographical locations of stakeholders, diversity of healthcare facilities, the flexibility of technology solutions, synchronisation of processes, and patients' data. Lastly, based on the interpretation of the findings the ETA framework for the implementation of the NHI was developed.

The study is of contribution from the theoretical and practical perspectives. The theoretical contribution is the study's addition to the academic existing literature. The developed ETA framework is also a contribution to the body of knowledge from the perspectives of health

informatics and IT development. From a practical viewpoint, the framework can guide the implementation of NHI in South Africa.

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DEDICATION

This study is dedicated to the memory of my late father S.T. Chitsa. I wish he could still be alive to share this academic achievement with me.

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LIST OF ABBREVIATIONS/ ACRONYMS

AA	**Application Architecture**
ANT	**Actor-Network Theory**
BA	**Business Architecture**
EA	**Enterprise Architecture**
EHR	**Electronic Health Record**
ETA	**Enterprise Technical Architecture**
GP	**General Practitioner**
HIS	**Health Information System**
HPRS	**Health Patient Registration System**
IA	**Information Architecture**
ICT	**Information Communication Technology**
IS	**Information Systems**
IS/IT	**Information Systems / Information Technologies**
IT	**Information Technology**
NHI	**National Health Insurance**
PHC	**Primary Health Care**
SAMA	**South African Medical Association**
TA	**Technical Architecture**
UHC	**Universal Health Coverage**
WHO	**World Health Organisation**

CHAPTER 1
INTRODUCTION

1.1. Introduction

The national health insurance (NHI) is a new universal health programme in South Africa. At the time of this study in 2021, the programme was being piloted. Owing to its newness, stakeholders constituting a complex mixed bag, the sensitivity of patients' datasets, and the complexity of information systems and technology (IS/IT) solutions, the implementation is inevitably challenging. This challenge can potentially derail the entire programme. From IS/IT perspective, the challenges can be associated with factors like lack of appropriate design and governance, which results in stagnation, technology infrastructures disintegration, information manipulation, and processes. Thus, an enterprise technical architecture is required to address the fundamental challenges in enabling and supporting NHI implementation.

The aim of the NHI is to ensure that all South Africans have access to good quality health care, despite their socio-economic status (Siegfried et al., 2017). The anticipated benefits of NHI, according to Marten et al. (2014), include the elimination of out-of-pocket payments, removal of salary bracket discrimination, provision of universal healthcare to all, with preference based on the illness and not affordability, among others. Cheng (2015) explains how the Taiwanese benefit from the country's NHI system, as they enjoy easy access to health services, including specialists, choice of healthcare provider, and short waiting times.

The NHI ensures extended coverage and increased access to health services regardless of socio-economic status (Cape, 2015). Therefore, it is intended to address challenges within the South African health sector, which have become severe due to the lack of equitable access to healthcare (Marten et al., 2014). The current health system is a two-tiered system that lacks equity as it is based on socio-economic status, and free healthcare services are only provided through public healthcare providers. Most of these public healthcare centres are often under-resourced, infrastructures are old and lack good quality, drugs are often out of stock, and there is poor disease prevention and control compared to private healthcare providers (Mhlaba et al. 2016). NHI, on the other hand, provides healthcare services through both certified private and public healthcare providers (Marten et al., 2014)

However, the implementation of NHI has proven to be challenging from a technology perspective. From the assessment of the ongoing pilot of the NHI, it was reported that at the end of 2018, 20-million people were registered, but poor connectivity, hardware problems, and lack of information technology (IT) staff hinder some clinics from accessing the internet (Child, 2019). It is also reported that poorly designed systems affect the implementation of IT systems in healthcare (Jeffries et al., 2017). Many IT solutions' challenges manifest from a lack of governance (Johnston & Gillam, 2019). According to Iyamu (2012), ETA bridges the gap between the enabler and the enabled, pragmatic assessment and technology solutions in addressing needs, and semiotics of IT solutions' deployment. The enterprise technical architecture stabilises the deployment and use of IT solutions in an environment (Zimmermann et al., 2013). Without architectural guidance, IT solutions encounter challenges and ultimately fail to enable and support goals and objectives towards fulfilment. Based on this concern and gap, this study examines and develops an enterprise technical architecture (ETA) framework to guide the implementation of the South African NHI.

1.2. Background to research

The use of IT in healthcare is commonly referred to as e-health (Boogerd et al., 2015). In Whitehouse et al.'s (2011) findings, e-health has become a fundamental part of health strategies in many countries. Of mention is the European Union, where e-health is very instrumental in improving access to quality healthcare (Whitehouse et al., 2011). However, IT comes with challenges, especially related to legal, ethical, and governance issues (Johnston & Gillam, 2019). This, in turn, affects several sectors, including legislators, policymakers and filters down to healthcare services users. Being a new programme in South Africa, there may be similar challenges when implementing and maintaining the NHI programme.

Due to the natural complexity of the healthcare systems, Phichitchaisopa and Naenna (2013) emphasise the need for IT to be always current, as it is vital for communication among the healthcare staff internally and externally. It is also required for surgical procedures and storing patient and resource data on secured databases across the different healthcare providers. Furthermore, they imply that to implement IT systems successfully requires a good interaction between the users, technology, social, and organisational processes.

According to Mhlaba et al. (2016), SA's current public health facilities are under-resourced and lack quality. Passchier (2017) suggests the need for investment in the use of new technology and improvement of data collection methods in the healthcare department for the implementation of

the NHI. Cheng (2015) argues that the introduction of the new technology and the emergence of new diseases can be a possible strain on the budget. Issues like connectivity, the complexity of systems, software and hardware reliability, and human resources, among others, can influence the implementation of IT-enabled systems such as NHI (Ross et al., 2016). As stated by Jeffries et al. (2017), poorly designed systems affect the implementation of IT systems in healthcare.

Regardless of the National Department of Health's efforts and investments towards the public e-health systems, the current South African e-health system is heterogeneous and faces challenges of interoperability (Katuu, 2016). Thus, the successful implementation of NHI is a point of concern as it requires combination, co-existence, and integration of various IT solutions (Martin et al., 2018). Interoperability is also paramount as medical data and information would be shared among private and public entities (Sajid & Ahsan, 2016).

1.3. Research Problem

The problem is that there seems to be no architecture from the technology perspective, specifically to guide the implementation of the South African National Health Insurance (NHI) system. The NHI is a new programme in South Africa, which needs technology solution enablement and support in its implementation. Otherwise, the implementation will be challenging and derailed like other systems and programmes, which were not enabled or supported by an architecture framework (Johnston & Gillam, 2019). Systems or computer-enabling programmes often fail because they lack governance (principles, standards, and policies), which disintegrate technology infrastructures and manipulate information and processes. Thus, an architecture framework is required to govern IT enabling infrastructures, business (NHI) processes, designs, and patients' information flow.

1.4. The study Aim

This study aimed to develop an enterprise technical architecture framework that can be used to guide the implementation of the South African NHI system.

1.4.1. Research Objectives

Based on the aim as stated above, the objectives of this study were as follows:

i. To examine the factors (such as process, governance, and legislature) that can influence the implementation of the South African NHI.

ii. To examine the technology infrastructures, information exchange, and business (healthcare) requirements for implementing the South African NHI.
iii. To develop an enterprise technical architecture framework based on the analysis of the findings from the objectives mentioned above.

1.4.2. Research Question

How can an enterprise technical architecture framework be developed to guide the implementation of the South African NHI system?

Research Sub-questions

i. What factors (such as process, governance, and legislature) can influence the implementation of the South African NHI?
ii. What are the technology infrastructures, information exchange, and business (healthcare) requirements required for implementing the South African NHI?
iii. Based on the responses to the above questions, how can the data be analysed to obtain findings that help develop a technical architecture framework?

1.5. Literature Review

This section focuses on the literature review covering Information Technology (IT), National Health Insurance (NHI), Implementation of NHI, enterprise technical architecture and the theory underpinning the study (Actor-Network Theory).

1.5.1. Information Technology

The use of information technology (IT) in the health sector improves the efficiency and effectiveness of the health care system (Devaraj et al., 2013), hence a need to invest more in IT in healthcare. Through big data analytic tools, diseases can be detected at early stages, correct treatment can then be given and thus reduce mortality rate (Raghupathi & Raghupathi, 2014). Through the use of IT, the records of patients can be accessed and monitored remotely, and the records can be stored electronically (Kellermann & Jones, 2005).

In western countries, the use of IT is at an advanced stage as compared to African countries. Leon et al. (2012) argue that there is poor IT infrastructure in most parts of South Africa, which impacts the adoption of IT systems in the health systems. There is a need to invest more in IT in health care systems as it increases the profitability of the hospitals, in terms of resources like

time, as computerised records are accessible faster than manual ones (Phichitchaisopa & Naenna, 2013). The use of IT is beneficial to the ageing community in the Western countries using the Personal Health System (PHS) that monitors their health every day (Peine & Moors, 2015).

As much as the use of IT in health care systems has been increasing and beneficial, it comes with challenges mainly regarding the concerns of security and privacy of sensitive data (Jiang et al., 2016).

1.5.2. National Health Insurance

UHC is an insightful goal from the World Health Organisation (WHO) (Tangcharoensathien et al., 2015). It is about ensuring that all citizens have access to the needed health services regardless of socio-economic status (Cape, 2015). Many countries like Canada, Brazil, Taiwan, the United States of America, the United Kingdom, to mention a few, have adopted the UHC approach and have health programmes whose benefits are similar (Reich et al., 2016). The South African NHI is a new programme meant to achieve the UHC goal (Siegfried et al., 2017). According to Marten et al. (2014), the anticipated benefits of NHI include elimination of out of pocket payments, removal of discrimination in terms of salary bracket, and provision of universal health care to all with preference based on the illness, not affordability, among others.

The main differences in UHC programmes are the challenges attributable to factors such as cultural, economic, and political settings of the countries (Odeyemi & Nixon, 2013). In the USA, Obamacare was not received well by the working and middle class that do not receive support and are paying much money for healthcare services (Oncology, 2012).

In order to achieve the goals of UHC, the NHI system needs to be financed (Liaropoulos & Goranitis, 2015). The South African NHI is expected to pool funds from the citizens' general tax revenue and tax contributions (McIntyre et al., 2009). However, the affordability of the South African government, as argued by Mhlaba et al. (2016), is said to be questionable.

1.5.3. Implementation of NHI

The goals of the NHI includes the provision of universal health coverage to all South Africans, improvement to the quality of healthcare services, provision of financial risk protection and mobile services, among others, as stated in the NHI white paper (South African National Department of Health, 2017). Like every other system, the NHI goals require IT solutions to enable and support

its operationalisation and fulfilment. These IT solutions include software, hardware, network, and processes (Aubakirov & Nikulchev, 2016).

The NHI implementation requires combining, co-existing, and integrating various IT solutions, such as software, hardware platforms, network protocols, and databases, to achieve its goals (Martin et al., 2018). Interoperability is paramount as medical data and information would be shared among different entities (Sajid & Ahsan, 2016). This is not easy without architectural deployment. Also, despite the interest and awareness to automate health information systems for NHI, which include transitioning from manual to electronic processes and interoperability of IT solutions, the deployment of technical architecture is still silent (Chitsa & Iyamu, 2019).

The challenges of implementing IT solutions can be due to the countries' cultural, economic, geographical, and political settings, among other factors (Reich et al., 2016; Odeyemi & Nixon, 2013). Brazil's unified health system, as explained by Santos et al. (2017), is still facing challenges due to geographical factors that affect the equitable distribution of healthcare services in terms of resources and technologies. Lack of standards can also affect the successful implementation of IT solutions (Hanseth & Bygstad, 2015).

1.5.4. Enterprise Technical Architecture (ETA)

In more generic terms, architecture is the art of designing a structure to manage its size and complexity (Fischer et al., 2010). An Architecture brings about pre and planned procedures that are useful when implementing systems' complexities, including integration and relationships of components (Hjort-Madsen, 2006; Fai & Donaldson, 2000). This study focuses on the technical architecture domain of the enterprise architecture (EA) (Shaanika & Iyamu, 2015). Enterprise technical architecture can be defined as a set of standard guidelines that can compel the choices of technology investment (Giachetti, 2016). Technical architectures can be applied in various systems because of their premise to provide a more solid foundation, enhanced support, and improved management approach (Chen et al., 2017).

Enterprise technical architecture has been employed to guide, support, manage, and govern IT solutions in many walks of life, including the health sector (Zimmermann et al., 2015). From a health system's viewpoint, Zhang et al. (2017) explain that architecture is important in a system's life in that it is used to guide data collection and management of applications. The need for systems in healthcare to support interoperability and data sharing makes it difficult to implement

or develop systems without an architecture (Hjort-Madsen, 2006). In the context of healthcare, Hayes (2010) argues that money can be saved if architecture is used to guide processes, including the selection and deployment of IT solutions.

The increasing interest in the technical architecture is primarily to prevent prohibitive circumstances, such as loss of data due to lack of security, lack of connectivity, increased procurement and maintenance costs of IT solutions, unreliability, incompatibility and uncertainty of software and hardware, among others (Aubakirov & Nikulchev, 2016). The Norwegian health sector experienced uncertainty of IT infrastructure and solutions acquired without an architecture, which led them to implement one (Olsen, 2017). With technical architecture, integration and interoperability problems in health care systems can be prevented (Sajid & Ahsan, 2016).

1.6. Theory underpinning the study

Originally developed for sociological studies (Waeraas & Nielsen, 2016), Actor-Network Theory (ANT) is a theory that is known for the idea that structures are dependent on nature and materials (Bilodeau & Potvin, 2016; Whittle & Spicer, 2008). ANT is a tool that maps together the technical and non-technical entities, as Bilodeau and Potvin (2016) stated. The theory focuses on how networks are created, transformed, maintained and how they may fall apart (Prado & Baranauskas, 2012). The main components of ANT, according to Heeks and Stanforth (2015), are networks, actors or actants (which can be human and non-human) and heterogeneous networks. Network refers to a group of interrelated elements whose communication is established through translation (Fenwick & Edwards, 2010).

According to Waeraas and Nielsen (2016), translation is a process by which the actants' resources with similar interests are mobilized mobilised and engaged to support claims to specific knowledge. The four stages or moments of translation, according to Callon (1984), are problematisation, interessement, enrolment and mobilisation. Figure1.1 shows the four moments of translation.

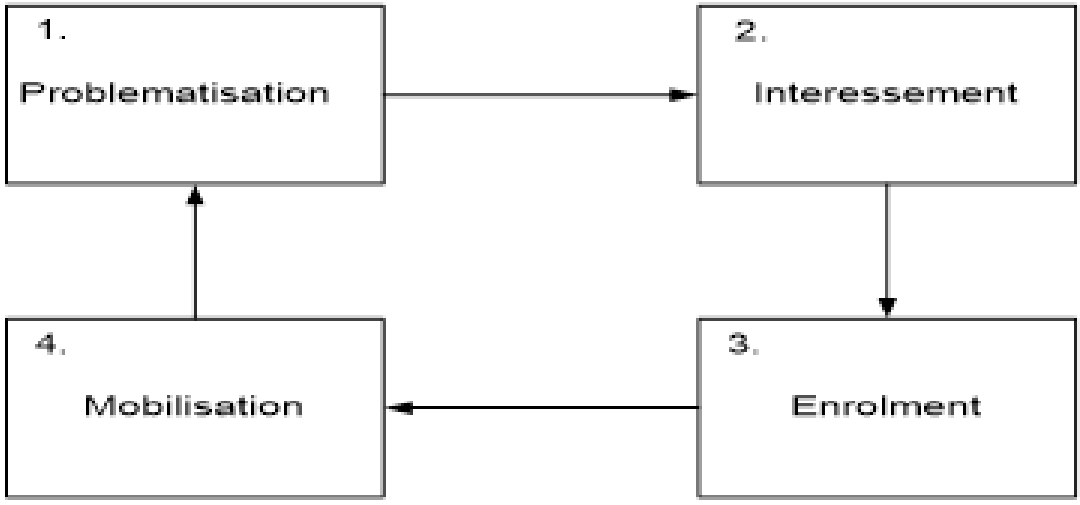

FIGURE 1. 1 FOUR MOMENTS OF TRANSLATION (CALLON, 1984)

Problematisation is the first stage of translation whereby the main actor initiates an issue (Waeraas & Nielsen, 2016). During the interessement stage, the focal actor intervenes to strengthen the relationships among the various actors interested in solving the posed problem (Heeks & Stanforth, 2015). As explained by Nehemia-Maletzky et al. (2018), enrolment is when the actors accept the roles they have to play and work with others to solve the problematised issue. Mobilisation is the last stage of translation. During mobilisation, a representative is chosen or volunteers to communicate the interests and roles of the network (Waeraas & Nielsen, 2016).

ANT is one of the Socio-technical theories increasingly used by scholars in the field of Information systems as lenses for inquiry (Iyamu, 2013). The theory helps to find answers to the phenomenon being studied, as it is used to examine how, what, and why certain things happen in the computing environment (Shaanika & Iyamu, 2015). ANT has been recently applied by Iyamu and Mgudlwa (2017) in their study to develop a framework for the transformation of big data. As argued by Bilodeau and Potvin (2016), ANT has the power to open up the black box of the interferences of the actors. In their study, Heeks and Stanforth (2015) applied ANT's moments of translation to investigate the effects of opening the black box of technological processes.

1.7. Research Design and Methodology

Research methodology is a systematic process that guides the identification and selection of approaches, methods, and techniques in research (Long, 2014). This section discusses the methodology and design applied in this research. Therefore, the discussion covers the research approach, methods, design, and data collection and analysis.

1.7.1. Research Approach

Abductive, inductive and deductive are the three types of research approaches commonly applied in information systems (IS) research (O'Reilly, 2012). In deductive research, the hypothesis is derived from existing theories (Sik, 2015) and abductive, as explained by Aneta and Jerzy (2013), is a combination of the inductive and deductive approaches.

The inductive approach, according to Long (2014), is mostly linked with qualitative studies and the researcher uses the data to derive the theories. In the opinion of DeJong et al. (2004), inductive research is more of a bottom-up approach, whereas deductive is a top-down approach. This study aimed to develop an enterprise technical architecture framework that can be used to guide the implementation of the South African NHI. Based on the aim of the study, the researcher followed the inductive approach mainly because the theory had not been tested yet.

1.7.2. Research Methods

There are two types of research methods: qualitative and quantitative. In addition, the two methods can be combined in a study, which is referred to as the mixed method (Astalin, 2013). The quantitative methods focus on statistics and measurement (Baxter & Jack, 2008). Bambale (2014) explains how the quantitative method focuses on numbers and not quality.

In order to fulfil the objectives of the study, which were (1) to examine the factors that can influence the implementation of the NHI in South Africa; and (2) to examine the technology infrastructures, information exchange, and business (healthcare) requirements for the implementation of the NHI in South Africa, and develop an enterprise technical architecture framework to guide the implementation of the NHI in the country, the researcher applied the qualitative research method. Qualitative methods focus on opinions and views and are mostly applied in studies where little is known, but deeper knowledge is required (Hancock & Algozzine, 2017).

1.7.3. Research Design

A research design is the systematic process of mapping research and is used in linking methods to answer the research questions (Wahyuni, 2012). In qualitative research, the commonly used designs include phenomenology, survey, ethnography, grounded theory, and case study (Astalin, 2013). The case study approach was employed in this study; therefore, it is the only focus of

discussion. The rationale for selecting the approach is discussed below. First, a description of the approach is presented.

The case study approach focuses on studying phenomena in natural settings (Yin, 2003). The approach focuses on inquiry of a phenomenon to better understand a bigger class of units (Yazan, 2015). This can be attributed to why the approach is often used when the researcher seeks to answer the how and why questions (Hancock & Algozzine, 2017) There are different types of case studies (George, 2019). According to Ridder (2017), a case can be; an individual, an organisation, a problem or an event. In this study, NHI is the case.

1.7.4. Data Collection

Data collection is a process that involves the gathering of data that is useful in the context of the study (Sutton & Austin, 2015). The common data sources within the qualitative methods include interviews, observations, document analysis and artefacts (Fusch & Ness, 2015).

In this study, the qualitative data was gathered using the document analysis technique. The technique helps extract specific insights and key information for the phenomenon being studied (Johnston, 2014). Document analysis is most appropriate for qualitative data (Guest et al., 2017). Also, insights into sensitive issues, as Sherif (2018) explained, can be provided through document analysis, which could be difficult to access using other techniques because of challenges like limited access. According to Bowen (2009), documents such as reports can be a source of empirical data for a study.

Only document analysis technique was used to collect data for this study. This was primarily because the NHI had not been implemented in the country. As a result, no one had the experience for empirical evidence, hence the choice to use relevant documents.

In order to collect the relevant and rich data in this research, the focus was on the following:

- The department of health
- South African private health sector
- The Pharmaceutical Society of South Africa
- South African medical association (SAMA)

The selection of the above-mentioned focus areas was based on the following: (1) The health department is the custodian of the NHI. (2) The implementation of NHI involves both private and public health sectors hence the inclusion of the South African private health sector, the Pharmaceutical Society of South Africa and the South African Medical Association (SAMA). The documents gathered include government gazettes, assessment of the NHI pilots progress reports, peer-reviewed research articles and NHI-related white paper from IT and health perspectives.

1.7.5. Data Analysis

Data analysis is a process of identifying, examining and interpreting collected data to find its meaning and usefulness (Neale, 2016). Through data analysis, the researcher makes sense of the collected data. Actor-Network Theory (ANT) was employed as a lens to guide the data analysis. The theory is discussed in the literature review section. The four moments of translation, namely problematisation, interessement, enrolment, and mobilisation, were used in the analysis. The focus of the analysis was primarily to:

- Identify and understand the human and non-human factors involved in the implementation of NHI
- Examine how networks are formed and how actors negotiate with their individual and group roles in NHI implementation.
- Examine the various processes and activities in the implementation of NHI in their heterogeneity.

Based on the findings, an enterprise technology architecture framework was developed.

1.7.6. Units of Analysis

Units of analysis specify what the case study is focusing on (Ridder, 2017). The research questions explored the main units of analysis. These units of analysis were technical (Technology infrastructure and healthcare Information Systems) and non-technical (NHI requirements and NHI governance) units.

1.8. Ethical consideration

Good research should benefit society (Artal, 2017). In this study, the researcher sought permission from the Informatics and Design Faculty of CPUT before conducting the study. The researcher treated every entity with respect and confidentiality. The data and information gathered from the department of health in the form of documents were used for this study only.

1.9. Significance of the study

The study developed an enterprise technical architecture framework to implement the NHI in South Africa. This architecture framework can be of significance to the South African government as it can use it as a guide to fully implement the NHI in the country. The healthcare practitioners and IT people in the health sector can also benefit from the study. They can use the architecture framework as a guideline when developing other similar architectures and to enable IT-related health systems. The successful implementation of NHI through this architecture framework will benefit the community of SA as a whole.

1.10. Delineation of the study

The study only focused on implementing NHI in South Africa from the IT perspective. It did not cover areas like readiness assessment.

1.11. Contribution of the study

The contributions of the study were from both theoretical and practical viewpoints. The architecture framework that was developed was of theoretical contribution because it had not been tested yet. Another aspect of the theoretical contribution is the study's addition to the existing literature. The architecture framework and literature contributed to the body of knowledge from the perspectives of health informatics and IT development. From a practical viewpoint, the enterprise technical architecture framework can guide the implementation of NHI in South Africa.

1.12. Outline of the study

This study is organised into six chapters.

Chapter 1: Introduction: This chapter presented the background of the study, the research problem, the research objectives and questions, and a brief of the entire study.

Chapter 2: Literature Review: This chapter provided the literature related to the study that was reviewed.

Chapter 3: Research Methodology: This chapter explored the research methodology that was employed in the study.

Chapter 4: Case overview: This chapter covered the overview of the case that was studied.

Chapter 5: Analysis of Data and the Discussion of the Findings: This chapter presented the data analysis, findings and interpretation, and the enterprise technical architecture framework for the implementation of the NHI.

Chapter 6: Conclusions and Recommendations: This chapter provided the summary, conclusion, and the recommendations related to the study.

1.13. Conclusion

This chapter presented and discussed the components necessary and relevant to the study, including the formulation of the research problem, objectives, and questions. The chapter presented a holistic literature review through which the gaps which motivated the study were identified. Also introduced in the chapter were the carefully selected research methods and techniques based on the aim and objectives of the study. These were discussed in the research design and methodology section. The ethical consideration, significance, and contributions of the study were also highlighted in the chapter.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter presents the literature review conducted in the study. The aim of the study, which was to develop an enterprise technical architecture (ETA) that can be used to guide the implementation of the South African National Health Insurance (NHI), guided this review. Thus, the review focused on information technology (IT), enterprise architecture (EA) and health care relative to this study. A review of the theory that underpinned the study was also conducted.

The chapter is divided into eight main sections according to the focused areas of the literature review, as follows: The first section is the introduction. The second section covers IT in the context of this study. NHI and its implementation are discussed in the third and fourth sections, respectively. The fifth section presents a brief discussion on EA, and the sixth section focuses on ETA. Actor-network theory (ANT), which underpinned the study, is discussed in the seventh section, followed by ANT's use in IS studies in the eighth section. Finally, a conclusion is drawn.

2.2 Information Technology

Information technology (IT) can be defined as computer systems and technologies used by people to facilitate the manipulation and transmission of information needed to achieve organisational goals (Botha & Booi, 2016; Shalannanda & Hakimi, 2016; Chetley et al., 2006). The use of IT, as argued by Selwyn (2003), transforms almost every aspect of society, from leisure to businesses, including education, manufacturing, healthcare, and retailing. IT consists of three main dimensions, namely: technology, people, and processes (Wang et al., 2018). The success of IT-enabled systems depends on the proper interaction and correct alignment of these three key dimensions (Chitsa & Iyamu, 2020; Cotenescu, 2016; Cresswell & Sheikh, 2013)

In the context of healthcare, the use of technologies, such as mobile technology, enhances service delivery and support (Free et al., 2013). Medical robotics and computer-based tools are being used to increase the quality of healthcare (Ashrafian et al., 2014). Healthcare processes are multidimensional and complex (Thornton et al., 2013). With the use of IT solutions, the patients' records can be accessed, monitored remotely, and stored electronically through the Electronic Health Record (EHR) (Tresp et al., 2016; Rahman & Reddy, 2015). Also, the medical results from the laboratories, for example, can be communicated instantly to the designated

entities for evaluation through the network technology at real-time. The use of IT solutions has enhanced productivity and quality of service delivery in many countries. For example, in Estonia, through e-prescriptions, almost 99 % of the country's medical prescriptions are issued electronically (Metsallik et al., 2018). This increases response time, and related resources can be maximized, as computerized records are accessible faster than manual ones (Metsallik et al.2018; Phichitchaisopa & Naenna, 2013).

Other useful aspects of IT solutions are in the areas of data digitalisation and data analytics, through which better decisions are made, and more awareness of patients' medical status can be provided (Iyamu, 2020; Tresp et al., 2016). In their study, Wang et al. (2018) posit that, through big data analytics, organisations such as healthcare can increase their business value by reshaping IT solutions for specific needs. In addition, the quality and efficiency of health care can be improved through the use of IT solutions from the perspective of clinical decision support systems (Tresp et al., 2016). This does not mean that there are no challenges with the selection, deployment, use and support of IT solutions (Iyamu, 2012). Some of the challenges are heterogeneity, interoperability, lack of qualified human resources, security, and information confidentiality (Gutierrez et al., 2017).

Despite the challenges that come with IT solutions, surfacing healthcare issues can be identified and proper decisions made through the use of reports from the analytic systems (Mehta & Pandit, 2018). The use of artificial intelligence systems and machine learning can also lead to disease diagnoses, drug discoveries and developments, and treatments (Free et al., 2013). According to Phichitchaisopa and Naenna (2013), healthcare service providers can reduce healthcare costs and medication errors by using appropriate data analytic tools. Chetley et al. (2006) summarised some of the benefits that can be gathered from using IT solutions in healthcare as; the collaboration of healthcare stakeholders at different levels, virtual diagnosis, and consultation (telemedicine) as well as easy distribution of health information.

Unlike other industries, the natural complexity of healthcare systems poses challenges to the significant role and potential value of IT investments (Tresp et al., 2016; Skinner,2003). Complexity in healthcare is due to the existence of multiple heterogeneous entities with different processes, activities, and objectives, including the sensitive nature of the environment. Thus, in their study, Chitsa and Iyamu (2020) emphasise the need for a proper selection of IT solutions to alleviate challenges such as the development and implementation of healthcare systems. Also,

this is because some healthcare IT systems (solution) lack the capabilities of manipulating disparate data (Chetley et al., 2006). Besides, Jiang et al. (2016) pointed out that the challenges of healthcare IT systems are mainly the concerns of security and privacy of sensitive data. An example is the USA's IT-enabled UHC which, according to Chitsa and Iyamu (2020:724), "was hacked the same day it went on live".

Insufficient and lack of correct data, as argued by Tresp et al, (2016), has an impact on the effectiveness and benefits of IT solutions in healthcare systems, possibly because of the rapidity and advent of different diseases (Cheng, 2015). Gutierrez et al. (2017) stipulated that in many developing countries, the challenges that are involved in the adoption and development of IT healthcare solutions potentially rise from factors like affordability, lack of qualified personnel and poor healthcare infrastructures. Thus, ready-made healthcare systems, as asserted by Botha and Booi (2016), may not be appropriate solutions for developing countries such as South Africa, as they lack adequate IT infrastructure (Botha & Booi, 2016; Leon et al., 2012). It is in this respect that Botha and Booi (2016), proposed that innovative health IT solutions should consider a country's healthcare infrastructures, policies, cultural, and economic factors, among others.

In a recent study by Iyamu (2020), it is argued that resistance to change by people is one of the non-technical factors which affect the adoption and use of IT solutions in the health care sectors. According to Tresp et al. (2016), some medical professionals do not seem to see the benefits of NHI due to lack of interoperability, hence they are sometimes reluctant to adopt the technology.

2.3 National Health Insurance (NHI)

Before the political shift from apartheid to the democratic dispensation, the South African healthcare system was racially affiliated and divided into two main groups: white and non-white (Ramklass, 2009). The whites, who were the minority, benefited from a well-resourced system, as compared to the non-whites who were the majority (Buisman & García-Gómez, 2014; Ramklass, 2009). There have been efforts to bridge this gap in the healthcare system post-1994. However, there are still hindering challenges, which manifest from lack of equity, and its two-tiered approach that is based on socio-economic status (Mathew & Mash, 2019). This inequality shapes the divide between the private and the public healthcare sectors (Mhlaba et al. 2016).

The private healthcare sector in the South African environment is said to have better resources. The primary challenge is that this section can be accessed by a minority of South African citizens

due to the high costs of the medical aid schemes and out-of-pocket payments (Ramjee et al., 2013). In contrast, at public healthcare facilities, the patients pay very little or nothing for primary health care needs (Passchier, 2017). Majority of South African citizens come from poor communities and cannot always afford the exorbitant services of private healthcare facilities. As a result, public healthcare facilities are always congested, leading to poor services from long waiting times by patients, poor infrastructure, scarcity of drugs, and shortage of qualified health professionals (Mhlaba et al., 2016).

The South African NHI is a programme focused on providing financial risk protection against healthcare expenses and increasing access to quality healthcare services for the citizens of the country (Siegfried et al., 2017; Setswe et al., 2015). The implementation of NHI is expected to be completed within 14 years, starting from the year 2012, under the auspices of the department of health (DoH) (Setswe et al., 2015). During this research in 2020, the NHI programme was being piloted in eleven districts countrywide, focusing on primary health care, health prevention, and promotion. This was primarily to test the practicality of the programme (Baleta, 2012). The pilot was supported and enabled by IT solutions. Evaluating, selecting, deploying, and integrating these factors was a challenge capable of derailing the process. Hence, architecture is critical (Chitsa & Iyamu, 2020).

The South African NHI programme tries to align with the World Health Organisation's Universal Health Coverage (UHC). The concept of UHC is premised on the need to ensure that all people access quality healthcare (Chitsa & Iyamu, 2020). This means that individuals should access the needed healthcare services, which include preventative health services, social support services for chronic diseases and disability, as well as the treatment of diseases or any other physical or mental injuries. (Wang et al., 2014). It is every country's goal to enhance the well-being of its people by providing equitable healthcare, and this can be achieved through UHC (Kieny et al., 2017). Some of the benefits of the UHC ultimately increase a country's life expectancy (Ranabhat et al., 2018).

Traditionally, healthcare is funded either through public or private health insurance (Berchick et.al, 2018). To achieve the UHC goals, however, a nation has to decide on either adopting a single-layer or multiple-layer financing and healthcare delivery system (Hsiao et al., 2019). The Single-layer system refers to a single health risk pool system, whereby the government is the only purchaser of the healthcare services on behalf of its citizens, whereas the multiple-layer is a

system whereby the health risks are not pooled nationwide but rather by different groups, based on employers, health status, age, and sex, among others (Hsiao et al., 2019). Both systems are supported and enabled by IT solutions. The differentiation defines the requirements for the evaluation, selection, integration, and deployment of IT solutions. This makes architecture crucial in adhering to appropriateness, standardisation, and governance (Iyamu, 2012).

The NHI refers to a publicly funded scheme that is managed by a country's government to ensure the healthcare cost of its citizens achieves UHC (Martin et al., 2018. The scheme provides finance for the needed healthcare to the citizens free of charge, by the accredited and committed private and public healthcare providers (Surender et al., 2016). The services of these accredited health professionals are paid for by NHI (Gaqavu & Mash, 2019). Although, affordability of the country's government is questionable, as argued by Mhlaba et al. (2016), the South African NHI is expected to pool funds from the general tax revenue and tax contributions from the citizens (Mcintyre et al., 2017).

The South African NHI is motivated by a realisation that the current health system is biased and undermines the rights of the unemployed citizens and the low-income earners (Sekhejane, 2013). Every citizen deserves good quality health care regardless of their social and economic status (Ranabhat et al., 2018). Thus, the NHI programme, as stated by Marten et al. (2014), is intended to address most of the challenges within the South African health sector by bridging the gap between the poor and the rich. The participation of the private health care sector in the programme can also reduce staff shortages and resource concerns of the public health sector (Mathew & Mash, 2019). This type of health programme is not unique to South Africa. Similar programmes have been adopted in many developed and developing countries across the globe (Marten et al., 2014). Many of these countries encountered one challenge or another, linked to IT solutions (Gutierrez et al., 2017).

In 2011, China successfully achieved universal coverage and realised the need after the outbreak of severe acute respiratory syndrome which cost the country economically (Yu, 2015). Attaining UHC in developing countries is difficult, thus China's experience can be a motivation and an example to developing countries, such as South Africa, that are in the process of adopting UHC (Yu, 2015; Odeyemi, 2014). In the UK, the programme was established in 1948 to provide healthcare for free and is referred to as the National Health Service (Asaria et al., 2016). According to Martin et al. (2018), the Canadian universal healthcare system, known as Medicare,

was built with the principle that healthcare can be accessed, based on need and regardless of affordability. The Brazilian goal to increase access to healthcare for its citizens, as explained by Macinko et al. (2015), gave birth to its national health system, referred to as the Sistema Único de Saúde (SUS).

Achieving universal coverage hasn't been without challenges in many countries. Of mention is Brazil, whose remote areas lack required qualified IT and health professionals, meaning complete coverage has yet to be achieved (Rao et al., 2014). In addition, Farzandipur et al. (2016), argues that the country's level of IT maturity is very low, as some hospitals keep patients' records on both paper and electronically. This can pose challenges to the success of implementing an IT-enabled system that requires interoperability and systems integration. A study by (Gutierrez et al. ,2017) proffered the development of IT solutions in the Brazilian health sector that enable the integration of management and healthcare processes. This, however, can be challenging without an architectural guidance. In China, challenges emanate from the existence of a digital divide and lack of standardisation of interfaces and protocols in the country's eHealth systems (Hong & Zhou, 2018; Zhao et al., 2010). In the USA, resistance by physicians to use IT systems, and the cost of hardware and software, according to Farzandipur et al. (2016), were the main challenges in adopting and implementing eHealth.

The Taiwanese healthcare and quality of life have improved because of UHC and life expectancy has increased significantly (Ranabhat et al., 2018). This could be mainly because the country embraced the single-payer system that ensures equity and efficiency (Hsiao et al., 2019). In Thailand, the country's Universal Health Coverage Scheme (UHS) has successfully reduced the gap between the rich and the poor, as well as out-of-pocket payments for all citizens, including the rich community (Tangcharoensathien et al., 2015).

2.4 Implementation of NHI

The term implementation in the context of health systems is defined by Sligo et al. (2017:86), as "a process of planning, testing, adapting and integrating Health Information System (HIS) so that technology becomes routinely used in an organization". Like every other system, NHI goals require IT solutions to enable and support its operationalisation and fulfilment (Chitsa & Iyamu, 2020; Ross et al., 2016). Patients' medical data are shared across a variety of stakeholders nationally, hence these IT solutions enable the interoperability of systems for the successful implementation of NHI (Martin et al., 2018; Sajid & Ahsan, 2016). Interoperability become a

challenge without architecture. In a study by Passchier (2017), the author calls for investment in IT infrastructures for the successful implementation of NHI in South Africa.

The implementation process, as stated by Sligo et al. (2017), requires organisational transformation that needs proper resources, time, as well as support, commitment, and the involvement of stakeholders from developing to implementing the system (Tao et al., 2015). The adoption of health systems is affected by poor IT infrastructure in most parts of the country (Chitsa & Iyamu, 2020; Leon et al., 2012). Automation is a prerequisite for the implementation of IT-enabled systems. The successful automation of systems, as argued by Wachter (2016), does not only depend on how effective the technology is, but also on people's behaviour and attitudes (Garavand et al., 2016). As a 'green field' for UHC, implementing NHI in the South African environment without architectural guidance can be inevitably challenging (Chitsa & Iyamu, 2020). The reports on the assessment and evaluation of the ongoing NHI pilot reveals that IT problems attributable to poorly designed systems at some clinics are affecting the implementation of the programme (Anon, 2019; Child, 2019).

Many nations have successfully implemented UHC schemes and each country encountered different challenges. The successful implementation of IT-enabled systems is attributable to technological, human, organisational, and managerial factors, with the human factors influencing the implementation of such systems the most (Sligo et al., 2017; Farzandipur et al., 2016). Also, Ross et al, (2016), argue that effectively implementing a system is determined by understanding the factors that influence the implementation of such a system and the need to formulate policies to support the use of IT for the successful implementation of the programme. Integrating Health Information Systems (HIS) is challenging, mainly because of different health care service providers with different systems designed by different providers (Zhao et al., 2010).

Different countries encounter different challenges in implementing IT-enabled programmes. These challenges indicate that implementing NHI in South African will be no exception, thus a call for the implementers to be more prepared. The implementation of the UK's NHS, their national electronic booking system, according to Hendy et al. (2007), lacked integration because the IT systems acquired independently lacked national standards. Some stakeholders could not adhere to the stipulated timelines in the implementation process of the NHS which led to the overall delay in the full implementation of the programme (Hendy et al., 2007). Issues of confidentiality and

security have led to the failure of several large-scale implementation of IT systems (Barrilleaux & Rainey, 2014; Hendy et al., 2005).

A study by Zhao et al. (2010) showed that the imbalance of health care conditions due to an extensive geographical area in China has impacted the implementation of e-health in the country. Sligo et al, (2017), also found that inadequate funding, lack of governance, insufficient IT resources, lack of involvement and good communication of stakeholders are some factors that constrain the successful implementation of HIS. Budgetary limitations can also pose barriers to the implementation of IT solutions. Garavand et al. (2016) indicate that appropriate budgeting by the policymakers and implementers of the systems may result in a logical and successful deployment of a system. However, Chitsa and Iyamu (2020) argue that too much focus on the programme financing at the expense of the enabler can affect the successful implementation of NHI. In their study, the authors further state the three factors which can influence the implementation of the South African NHI: political issues, lack of balance between the enabler and the enabled, and the seclusion of ETA (Chitsa & Iyamu, 2020).

Besides, Farzandipour et al. (2020) postulate that challenges in implementing IT solutions can emanate from not recognising the correct technical requirements. The need for interoperability of systems and the complex nature of the health systems, as explained by Tao et al. (2015), pose huge challenges in the implementation of systems like NHI. Thus, the reliability of hardware and software, as well as connectivity, can influence the implementation of IT-enabled systems such as NHI (Chitsa & Iyamu, 2020). The authors, therefore, propose the deployment of an enterprise technical architecture for the successful implementation of the South African NHI programme (Chitsa & Iyamu, 2020). ETA simulates the technology infrastructure and allows the selection and use of appropriate software and hardware technologies needed when implementing complex systems (Iyamu, 2011; Hjort-Madsen, 2006).

2.5 Enterprise Architecture

Enterprise Architecture (EA) is a term with many definitions. In their study, Sajid and Ahsan (2016) define EA as a mechanism that enables the alignment and connection of IT and the business processes of an organisation. Ahsan et al. (2009) argue that EA is the most eminent architecture that outlines the relationships between the strategic vision of an organisation and different levels of IT infrastructure. Thus, EA in the context of healthcare, can be defined as a tool used for mapping healthcare IT fundamentals with the contemporary and coming healthcare processes.

The use of IT in healthcare enables the sharing of data and information among different entities. However, this remains a challenge in many healthcare organisations due to disjointed systems (Martin et al., 2018). The deployment of an EA in the implementation of complex health IT systems such as NHI, according to Sajid and Ahsan (2016), can solve the problems of integration and interoperability of systems. Also, EA guides the organisation's processes and the corresponding IT infrastructures to achieve organisational goals (Hjort-Madsen, 2006). Thus, through EA, business needs can be met as the mechanism, according to Aziz et al. (2005), connects the IT strategy and business strategy as seen in figure 2.1.

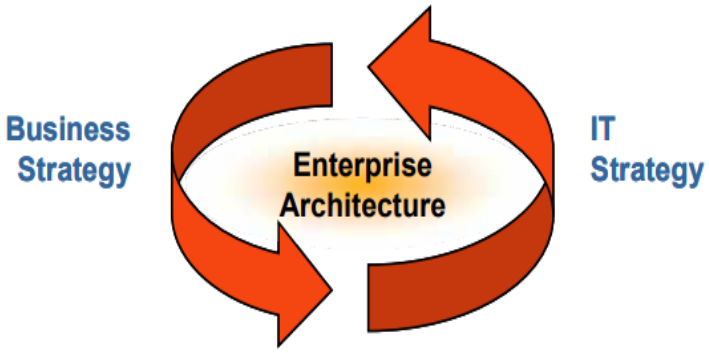

FIGURE 2. 1 ENTERPRISE ARCHITECTURE (AZIZ ET AL., 2005:2)

EA comprises a variety of domains, and each domain produces different deliverables with its boundaries. Based on the aim of this study, which was to develop an ETA, the embraced EA domains were Business Architecture (BA), Application Architecture (AA), Technical Architecture (TA), and Information Architecture (IA) (Chitsa & Iyamu, 2020; Sajid & Ahsan, 2016; Mphahlele & Iyamu,2015; Iyamu, 2011; Pulkkinen, 2006; Aziz et al., 2005).

BA domain, according to Mphahlele and Iyamu (2015:172), "represents the enterprise model, which includes service exchanges and financial flows in value networks and strategies". TA manages the technologies of an organisation intending to provide and maintain an adaptive technological infrastructure (Iyamu, 2012; Pulkkinen, 2006). IA, as explained by Pulkkinen (2006), is the domain that confines the organisation's information. And lastly, the AA domain is intended to manage designing and deploying applications needed to achieve organisational goals (Iyamu, 2011). Categorising these domains, according to Chitsa and Iyamu (2020), is critical.

2.6 Enterprise Technical Architecture

Enterprise Technical Architecture (ETA) is one of the domains of EA. Like the other domains, it is a model that uses unique technologies to attain its deliverables (Castellanos & Correal, 2012). An ETA, as explained by Iyamu (2012:190), “ensures that existing and new information technologies and systems are maintained and selected to achieve the strategic goals of the organisation”. Implementing IT-enabled systems in many developing countries is often derailed by the absence of ETA guidance (Iyamu, 2020). Through standards and principles, ETA guides selecting and choosing technology investments that support the integration and interoperability of systems during the implementation of complex systems such as NHI (Chitsa & Iyamu, 2020). An ETA framework consists of interdependent and unique domains namely middleware, data, security/ distributed, platform, and network domains (Iyamu, 2020; Iyamu,2012). The explanation of these domains is represented in Table 2.1 below (Iyamu,2012).

TABLE 2. 1 TECHNICAL ARCHITECTURE DOMAINS (IYAMU, 2012:197)

Technology Domains	Description	Technology Categories	Process/Procedural
Data Architecture	Defines the mechanics for managing, securing, and maintaining the integrity of the organisation’s significant logical entities. These entities are recorded and accounted for in the business information environment. The architecture provides standards for accessing data, as well as business objects, if appropriate.	Data and Object Repositories, Data Encyclopaedia, Data Modelling, Replication and Administration Tools, Object-oriented Databases.	Based on the business requirements, principles are formulated, within which data is classified and managed; and technologies selected and deployed.
Middleware Architecture	Defines the components that create an integration environment between user workstations and legacy and server environments to improve the overall usability of the distributed infrastructure. It creates uniform mechanisms for application integration independent of network and platform technologies.	Remote Procedure Calls (RPC), Messaging-Oriented Middleware (MOM), Object Request Brokers (ORBs), Transaction Processing (TP) Database (DB) Gateways.	The business and technical requirements dictate the principles and standards in the selection and deployment of technology.

Technology Domains	Description	Technology Categories	Process/Procedural
Network Architecture	Provides the communication infrastructure for the distributed computing environment. It consists of logical elements, physical hardware components, carrier services, and protocols.	Network Hardware, Network Operating Systems, Security, Carrier and Internet Services.	The business and technical requirements guide the design and management of the network.
Platform Architecture	Defines the components of technology infrastructure, including the client and server hardware platforms; the operating systems executed on those platforms; and the database environments and interfaces supported.	Hardware (Workstations, Servers), Operating Systems, Database Management systems.	Based on the business and technology requirements, principles and standards are formulated, within which technologies are selected, deployed and managed.
Distributed Architecture	Defines how the hardware and software components of the environment will be managed. It focuses on issues of configuration management, fault detection and isolation, testing, performance measurement, problem reporting, and software upgrades and controls.	Network Systems, Configuration, Storage Management and Security, Performance Management, and Capacity Planning.	Based on the business and technology requirements, principles and standards are formulated, within which technologies are selected, deployed and managed.

The use of the ETA framework in the deployment of IT systems in healthcare can increase productivity, as the healthcare IT will be aligned with present and future needs (Hayes, 2010). Employing architecture in healthcare can reduce the IT costs of the organisation, as it enhances the interoperability and integration of data across the stakeholders (Sajid & Ahsan, 2016; Hayes, 2010). Of mention is the case of China's health system; there is less medical cost as a result of a reduction in the duplication of medical examination due to the successful implementation of their Regional collaborative medical system, guided by an Architecture (Zhao et al., 2010). The data architecture domain of the ETA, as explained by Zhao et al. (2010), was employed in the

development and implementation of the community medical sharing system and the system enables medical data and information recording, sharing, and integration which is a common problem in healthcare systems implemented without architectural guidance (Ahsan et al.,2009).

The success of Estonia's national health information systems is because of the fact that most of their health IT projects are guided by architectures (Widén & Haseltine, 2015). However, these architectures, according to Castellanos and Correal (2012), have to be flexible to incorporate possible adjustments emerging from technology changes.

Lack of architectural guidance, according to Ahsan et al. (2009), led to the failure of many IT projects in the UK's NHS that do not support interoperability and integration. The alignment of the healthcare objectives and the IT systems, as posited by Price et al. (2018), remains the main challenge in implementing IT systems in the healthcare sectors if the process is not guided by an architecture. A successful implementation of a complex and huge project system such as NHI requires exceptional management and understanding of the complicated heterogonous actors and processes involved (Price et al., 2018). This can be difficult without architectural guidance. Lack of standards, a comprehensive eHealth strategy, and IT development costs, as stated by Widén and Haseltine (2015), are some of the challenges faced in deploying health information systems.

The current pilot project of the implementation of SA's NHI, according to a recent study by Chitsa and Iyamu (2020), is not guided by any architecture. This has resulted in many IT related challenges as reported by Child (2019). These challenges include hardware and software failures, lack of internet connectivity, and unqualified IT staff at some of the clinics (Chitsa & Iyamu, 2020; Child, 2019). Chitsa and Iyamu (2020) further explain how SA's health documents and policies are missing the discussions about the importance of the deployment of ETA in the implementation of NHI. Without architectural guidance, the implementation of NHI can be derailed by prohibitive circumstances such as non-compatibility of hardware and software, lack of connectivity, consistent loss of data and information due to poor data security measures (Chitsa & Iyamu, 2020; Aubakirov & Nikulchev, 2016).

2.7 Actor-Network Theory

Actor-Network Theory (ANT) is one of the socio-technical theories often used by researchers to guide the collection and analysis of data (Iyamu, 2013). The use of socio-technical theories helps

to examine how, what, and why certain things happen in the IT environment (Shaanika & Iyamu, 2015; Iyamu, 2013). The development and implementation of new technology, as explained by Timpka et al. (2007), involves a network of actors that consists of technical and non-technical elements. ANT focuses on how those networks are created, transformed, maintained, and how they may fall apart (Prado & Baranauskas, 2012). In the context of healthcare, ANT can be applied to get a clearer understanding of the healthcare operations and processes, the impact of IT, as well as the interaction of the healthcare stakeholders with the technology to achieve organisational goals (Muhammad & Wickramasinghe, 2016). Key concepts of ANT according to Heeks and Stanforth (2015) include; Actor-Networks, actors (or actants), translation, punctualisation, and black-box. Only the concepts necessary for this study were explained in detail.

Actor – Actors are also referred to as actants. In the perspective of ANT, actors refer to all the human entities and non-human things such as technological artefacts (Durepos, 2008). Different from other socio-technical theories, ANT treats both human and non-human actors as equivalent as long as they can act or be acted on, which is a concept referred to as generalised symmetry (Cresswell et al., 2010). The actors of ANT can be described as anything that originates an action. Actors are heterogeneous, meaning that they represent different political, psychological, technological or social groups (Fenwick, 2010). The actors' level of commitment is also different as they come with varying constraints and preconceived ideas (Williams-Jones & Graham, 2003). In the context of healthcare, actors can vary from healthcare practitioners, the IT personnel, the administrative staff, health facilities, IT resources as well as non- technical entities such as processes and medications (Makovhololo & Iyamu, 2020).

Actor-network – A network in ANT can be defined as a group of actors with similar interests (Iyamu, 2013). Hence the term actor-networks. These networks are heterogeneous as they represent the various connections between different actors in a network. The connections of actors creating networks are either intentional or unintentional. According to Shaanika & Iyamu (2015), the most important aspect of networks is to allow different actors to come together and solve a common problem. Thus, actors such as people, standards, organisations, processes, and technology artefacts with aligned interests influence other actors in a network to achieve its goals (Muhammad & Wickramasinghe, 2016; Cresswell et al., 2010). Actors, according to Callon

(1984), can be in more than one network playing different roles. As such, subnetworks can be formed from main networks. In the context of healthcare, different networks are formed either voluntarily or naturally. Of mention are networks influenced by specialisation, ethnicities, as well as roles and responsibilities (Makovhololo & Iyamu, 2020).

Translation – Actor-networks formation involves the recruitment of actors (human and non-human), through translation (Afarikumah & Kwankam, 2013). Within ANT, Translation can be defined as a concept whereby the main actor guides the building of a network through the identification and interaction of actants with interests to solve a common problem (Elbanna, 2011). Thus, through translation, actors with similar interests engage to form a heterogeneous network. The transformation of these networks involves identifying the intention of a network and negotiations to attract actors to be part of the networks (Iyamu,2013). These networks, however, are naturally not stable, hence the need for the commitment of the enrolled actors to keep focused otherwise the network may fail. This formation of networks through translation occurs in a series of stages referred to as moments of translation (Callon, 1984).

Moments of translations – The translation process, as described by Callon (1984), comprises four moments, namely problematisation, interessment, enrolment, and mobilisation as depicted in figure 2.2 below.

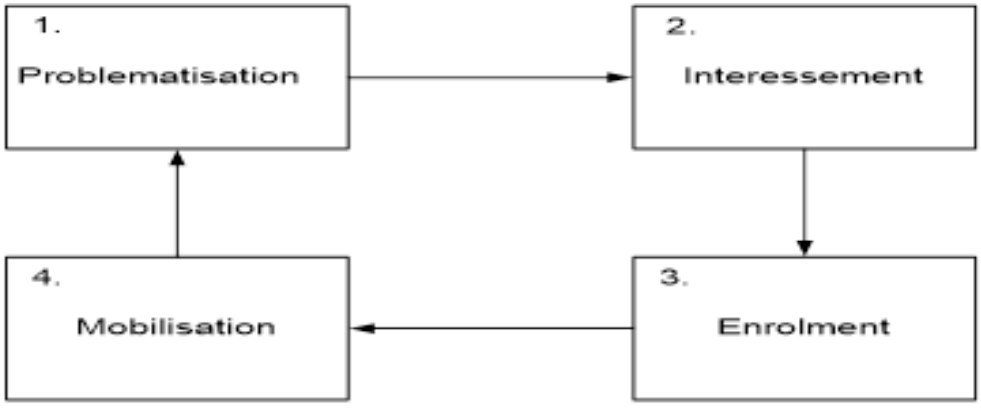

FIGURE 2. 2 FOUR MOMENTS OF TRANSLATION (CALLON, 1984)

Problematisation - The first moment of translation is problematisation, whereby the main actor identifies the problem or an issue to be solved (Iyamu, 2013). It is during this stage that different roles and responsibilities of the actors are identified as well as the deliverables of the proposed solution (Iyamu, 2013). Thus, problematisation entails the proposition of a network to other actors by the main actor (Afarikumah & Kwankam, 2013).

Interessement – interessement is the second moment of translation that explains how actors are recruited to be part of a network meant to solve the problem problematised in the first stage of the moment of translation. During this stage, the main actor attracts the attention of other actors by proposing different roles and responsibilities with the intention of locking different actors into a network (Heeks & Stanforth, 2015).

Enrolment – Different actors may show interest in solving the problem that has been presented by the main actor. However, not all of these actors actually participate in solving the problem. Enrolment is the third stage of translation, and it is during this stage that different actors accept the roles proposed by the focal actor and join in finding a solution to the problem, guided by rules (Waeraas & Nielsen, 2016). Enrolment thus involves the actual participation or action of actors in a network. The participation of human actors during this enrolment stage happens either consciously or unconsciously and is guided by rules and regulations (Makovhololo & Iyamu, 2020; Iyamu,2013). During the implementation of healthcare systems, the participation of non-technical actors, such as policies and processes, can thus be considered as obligatory, as their presence is mandatory.

Mobilisation - The last stage of translation is mobilisation. Mobilisation entails the communication of the interests and roles of actors and the formed network by the spokesperson or the representative of that network (Shim & Shin, 2016). In their study, Makovhololo and Iyamu (2020) stipulate that during mobilisation, “the focal actor needs to continually convince the actors that their interests are still the same” (Makovhololo & Iyamu, 2020:7) Thus, the mobilisation process is intended to strengthen the formed network (Iyamu,2013).

Socio-technical theories like ANT are being used to underpin studies mainly to get the know-how of the development and implementation of IT-enabled systems (Iyamu,2013). Through ANT, issues like integration and operability of systems can be facilitated as the theory enables a deeper insight into how human and non-human actors interact to form a network (Cresswell et al., 2010). According to a study by Afarikumah and Kwankam (2013), the concept of ANT has been applied to implement many IT projects. Thus, ANT has the capabilities of unpacking the complexities involved in implementing healthcare systems such as NHI.

2.8 Actor-Network Theory and information systems studies

From the sociological background, as stipulated by Bilodeau and Potvin (2016), ANT is one of the popular socio-technical theories applied in Information Systems studies. Its popularity and significance according to Iyamu (2013), are seen in the birth of a journal dedicated to the theory (International Journal of Actor-Network Theory and Technological innovation). ANT is used by many researchers in the IT field mainly as a lens to the inquiry during the data collection and analysis stages (Makovhololo & Iyamu, 2020). The theory has the capabilities of bringing about the rigour which, according to Cresswell et al. (2010), may be lacking in the traditional research approaches but are needed in IT studies (Iyamu, 2013: Cresswell et al., 2010). The use of theories, such as ANT, in IT studies is mainly to "investigate and understand why systems are developed the way they are; why infrastructures and IS are deployed with the approach they are deployed; the interactions that take place during systems development and implementation, as well as the deployment of infrastructures; and the implications of these interactions and their intended and unintended consequences" (Iyamu, 2013:224).

Over the years, ANT has been applied in many health informatics studies (Price et al., 2018). Of mention is a study by Cresswell et al. (2010), in which the authors applied ANT to get an understanding of the process involved in the implementation of IT developments in healthcare. Issues such as integration and operability can be identified before the implementation process (Cresswell et al., 2010). Muhammad and Wickramasinghe (2016) also applied ANT as a lens in their study to evaluate the benefits of e-health solutions in the Australian healthcare system. ANT's four moments of translation was applied recently by Makovhololo and Iyamu (2020) in their study to understand the impact of language barriers in South African healthcare.

2.9 Conclusion

In this chapter, the literature related to the study was reviewed. Based on the aim presented in Chapter 1, the focus areas of the literature review were NHI, Implementation of NHI, Information Technology (IT), and Enterprise Technical Architecture (ETA). The theory that underpinned the study, which is Actor-network theory (ANT), was also reviewed, with the main focus on the ANT's four moments of translation which guided the data collection and analysis. Lastly, the use of ANT in IS studies was discussed, highlighting the strengths and popularity of the theory in IS studies.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

Research methodology is a systematic process that "comprises the underlying sets of beliefs that guide a researcher to choose one set of research methods over another." (Wahyuni, 2012:72). Research methodology informs the types of research methods to be employed and help to also incorporate the philosophical assumptions for the study (Long, 2014). Thus, in this chapter, the rationale for the philosophical assumptions, research approach, methods, and design employed in the study are explained. Also, explained in this chapter are the data collection and analysis techniques applied in the study, including the corresponding ethical considerations. Lastly, the summary of the chapter is presented in the conclusion.

The selection of the methodologies was guided by the main aim of the study, which was to develop an enterprise technical architecture. The study adopted the research onion developed by Saunders et al. (2019), and this is represented in Figure 3.1.

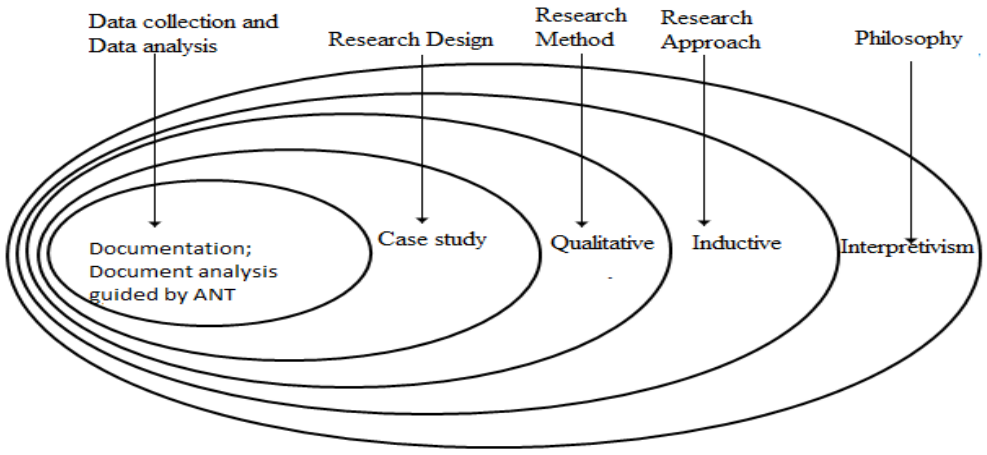

FIGURE 3. 1 THE RESEARCH ONION MODEL: ADAPTED FROM (SAUNDERS ET AL., 2019)

The methodology is articulated in the following sections.

3.2. Philosophical assumption

Research philosophy "refers to a system of beliefs and assumptions about the development of knowledge" (Saunders et al., 2019:163). Philosophical assumptions underpin the methodological

choices of research, which then influence the choice of research design, data collection and analysis techniques to be employed in a study (Wahyuni, 2012). There are three main common philosophical assumptions in research, namely ontology, axiology, and epistemology (Saunders et al., 2019: Wahyuni, 2012).

Ontology is about the realities of the things that already exist. A researcher's ontological assumption shapes how the research entities are studied (Saunders et al., 2019). On the other hand, epistemology is about the knowledge that is known and what can be gained from something that exists. Epistemological assumption refers to "what constitutes acceptable, valid, and legitimate knowledge, and how we can communicate knowledge to others" (Saunders et al., 2019:166).

There are different perspectives of epistemological assumption, including positivism, interpretivism, pragmatism, and critical realism. However, positivism and interpretism are the more classical ones (Wahyuni, 2012). The positivism perspective is purely objective. Positivists assume that "knowledge is obtained by observation and finding event regularities, which are based on casual, law-like and functional relations" (Melnikovas, 2018:35). In contrast, interpretivists, as argued by Wahyuni (2012:71) "believe that reality is constructed by social actors and people's perceptions of it". Thus, epistemological interpretivism is subjective, and the knowledge that can be acquired is comparable. The pragmatist perspective, on the other hand, is not limited to either interpretivism or positivism but considers both (Saunders et al., 2019).

The frame of thinking that led to the development of ETA was influenced by both ontological and epistemological assumptions. For this study, what was known ontologically is that NHI existed and was being piloted in the country; hence the need to develop an ETA which can be used to guide the implementation of the NHI system in the country. Epistemologically, what could be known were the requirements and the factors that could influence the implementation of NHI. The interpretivist approach was employed in the study. Interpretivism seeks to examine and understand why and how certain things happen. Thus, through the analysis and interpretation of the qualitative data in this study, the interpretivist perspective enabled the subjective understanding of the technical and non-technical factors for the implementation of NHI, leading to achieving the main aim of the study which was to develop an enterprise technical architecture framework.

3.3. Research approach

The process of choosing the research approach is the second stage in the construction of research methodology, as shown in Figure 3.1. Every study involves a theory and there are three research approaches to developing theory in research. These are deductive, inductive, and abductive (Saunders et al., 2019). These approaches according to Melnikovas (2018:34) "can be implied by the research philosophy on the previous level".

3.3.1 Inductive approach

In this study, an inductive approach to reasoning was employed. Inductive, as explained by Saunders et al. (2019), is mostly informed by the interpretivist philosophy and is common in qualitative research studies. Inductive approach "formulates theories and propositions with alternative explanations from observations and patterns" (Håkansson, 2013:71). The use of the inductive research approach was influenced by the objectives of the study and the ontological and epistemological assumptions stated in the previous section. Thus, through inductive reasoning, the enterprise technical architecture was developed. The ETA developed in the study is an untested theory based on the subjective analysis of the qualitative data in the form of documentations collected.

3.3.2 Deductive approach

As posited by Håkansson (2013:71), the deductive approach "derives conclusions from known premises". In contrast with inductive approach, in deductive reasoning, the data collected is used to evaluate the hypothesis (Saunders et al., 2019). This approach, therefore, involves objecting or confirming an existing theory. The approach is normally implied by positivists and common in quantitative studies that entail measuring facts (Melnikovas, 2018).

3.3.3 Abductive approach

The Abductive approach is the form of research approach that combines both deductive and inductive reasoning to come up with an outcome. The approach may be applied in instances where an existing theory is used to modify or develop a theory (Saunders et al., 2019). The abductive approach "aims to identify structures, connections, contexts, and constraints, and involves the use of cognitive argumentation" (Melnikovas, 2018:38). Like other approaches, the abductive approach is implied by the pragmatist perspective and the outcome tends to be mostly heuristic. The abductive approach commonly influences mixed methods which involve both quantitative and qualitative research methods.

3.4. Research method

Research method can be defined as "a practical application of doing research" (Wahyuni, 2012:72). Three types of methods commonly applied in research studies are qualitative, quantitative, and the mixed methods (Saunders et al., 2019: Melnikovas, 2018: Wahyuni, 2012: Baxter & Jack, 2008). Research methods, as seen in Figure 3.1, form part of the third layer of the "research onion". In addition to the objectives of a research, the choice of a method to be employed in a study is mostly informed by the two outer layers which are research approach and philosophical assumptions. In order to answer the how questions of the study, the qualitative research method was applied. The research questions and objectives of this study are explained in Chapter 1.

3.4.1 Qualitative research method

Qualitative methods focus on opinions and views and are mostly applied in studies where little is known but deeper knowledge is required (Algozzine & Hancock, 2016). Researchers in qualitative studies, compared to quantitative, "assume that social reality exists independent of the knower, and knowledge is subjective and personal" (Long, 2014:428). Qualitative research methods mostly involve non-numeric data and the researches are usually underpinned by interpretivism. Håkansson (2013:4) explains that, unlike quantitative methods, the qualitative method "uses smaller data sets that are sufficient enough to reach reliable results, where the data collection continues until saturation is reached".

According to Saunders et al. (2019), qualitative methods can be classified as either mono-method or multi-method. The difference between the two is centred on how the data is collected. The qualitative studies which use a single data collection technique are referred to as mono-method qualitative studies (Saunders et al., 2019). A multi-method qualitative study on the other hand, "refers to using more than one data collection technique and applying multiple methods to analyse these data, using non-numerical (qualitative) procedures to answer the research question" (Wahyuni, 2012:73).

This study applied the mono-method qualitative research method. The rationale for this method is the autonomous use of documentation technique to collect the non-numeric data for the study. The data collected comprised strategic and technical documents. These were analysed and interpreted subjectively to better understand how to develop a technical architecture framework

for implementing NHI. The data collection and analysis techniques applied in this study and rationale thereof are explained in sections 3.6 and 3.7.

3.4.2 Quantitative research method

Quantitative research methods are associated with numbers and measurements. Thus, most quantitative studies start with a hypothesis. According to Long (2014:428), researchers in quantitative studies, "assume that there is a social reality external to the knower, and knowledge is objective and tangible". This method is commonly applied in studies that involve experiments and measuring variables to object or confirm theories (Håkansson, 2013). This allows researchers to simply observe the relationships among variables and apply statistical analysis techniques to achieve the objectives of the study.

3.4.3 Mixed method research

Both qualitative and quantitative research methods can be applied in a single study, referred to as mixed-method (Astalin, 2013). The combination of these methods varies, depending on the objectives of the study. It can be done sequentially or concurrently (Saunders et al., 2019). The application of mixed-method in research is primarily to "achieve different aims and offset the constraints of the use of a single method" (Melnikovas, 2018:39). Saunders et al. (2019), argue that mixed research methods, are usually applied in abductive reasoning approach and are associated with pragmatist and critical realism.

3.5. Research design

Research design, also known as a research strategy, can be defined as a plan of action to address research questions to achieve the objectives of a study (Saunders et al., 2019). The common research designs used in qualitative research studies include ethnography, case studies, phenomenology, survey, and grounded theory (Saunders et al., 2019: Astalin, 2013). Research designs, as shown in Figure 3.1, are said to be influenced by the research methods; however, Wahyuni (2012) argues that some research designs such as case studies, can also be used in either quantitative or mixed research methods studies. Thus, the choice of the research design in a study has to be based on the objectives of the study (Saunders et al., 2019).

The case study research design was employed in this study. Based on the research questions of the study as explained in Chapter 1, there was a need for an in-depth investigation of the phenomenon (NHI); hence, the case study was seen as the most appropriate design. A case

study “facilitates a deep investigation of a real-life contemporary phenomenon in its natural context” (Wahyuni, 2012:72).

3.5.1. Case study design

A Case Study is an in-depth study of a phenomenon in its natural context (Saunders et al., 2019: Yazan, 2015). The design is often applied in qualitative studies which seek to answer the how and why questions (Algozzine & Hancock, 2016). According to Wahyuni (2012), to gain more insight into a phenomenon, it is best to study multiple cases instead of a single case in case study designs. A case can be an individual, an organization, a problem, or an event (Ridder, 2017).

It was essential to select a case that reflected the main objective of the study. Hence, a single case was selected and investigated, which is the South African National Health Insurance (NHI). As a new phenomenon, which at the time of this study had yet to be fully implemented, the selection of NHI as a case enabled a deeper understanding of the process, legislature, technological, and non-technological factors that affect the successful implementation of the system in the country. The overview of the case is explained in Chapter 4.

3.6. Data collection

Common data collection techniques in qualitative research studies include interviews, documentation, and observations or a combination of these techniques (Fusch & Ness, 2015). Interviews are said to be the main data collection technique in qualitative studies. In support, Wahyuni (2012) states that “qualitative researchers should get involved in a communication with the practitioners in the organisational coal-face in order to better understand the current state of real-world practices” (Wahyuni, 2012:72). However, document analysis can also be used autonomously to collect data in qualitative case studies (Bowen, 2009).

During this study, NHI had not been implemented in the country, hence no persons had an experience that could be used as empirical evidence. Thus, the document analysis technique was the only feasible data collection method, and empirical data was obtained from the evaluation of relevant documents.

The details of the documents that were accessed and consulted are presented in Table 3.1. The main documents were obtained from the online repositories and public domains of the sole custodian of NHI, which is the department of health. Other documents, such as assessments of

the NHI pilots progress reports and updates of the ongoing pilot system were accessed from Health and IT databases, as well as Google Scholar.

During the documents gathering, the researcher took note of "authenticity, credibility, accuracy, and representativeness of the selected documents" (Bowen, 2009:33). The 13 documents were selected using some criteria. The criteria included 1) the selection of documents relating to the South African NHI only, thus any other NHI documents not relating to SA were not considered. 2) the documents must have been approved by the relevant authority such as the national parliament. 3) the documents must have been published between 2011 and 2021. The time frame was set to ensure data relevance as well as to get an understanding of the historical background of the SA NHI since the Green Paper on National Health Insurance was published in 2011.

In addition, guided by the objectives of this study, use of keywords were used in searching for the documents. These keywords include the implementation of the South African NHI, technical architecture, and IT and healthcare in South Africa. The process enabled the researcher to pull complete and most relevant documents which included policy documents, strategic documents, reports detailing the progress of the current pilot programme, and technical documents. These documents are presented in Table 3.1 below.

TABLE 3. 1 DOCUMENTS COLLECTED

#	Type of document	Description	Quantity (pages)	
1	Government Gazette	White paper on the National Health Insurance. Gazetted, 30 June 2017. No. 40955	80	https://www.gov.za/sites/default/files/gcis_document/201512/39506gon1230.pdf
2	Government Gazette	The national Health Insurance policy. Gazetted, 11 December 2015. No. 39506.	98	https://www.gov.za/sites/default/files/gcis_document/201512/39506gon1230.pdf
3	Policy paper	The policy document for the South African NHI	59	https://www.gov.za/sites/default/files/nationalhealthinsurance.pdf
4	Strategic document	The National eHealth Strategy, for South Africa for the period of 2012/13-2016/17	36	https://health-e.org.za/wp-content/uploads/2014/08/South-Africa-eHealth-Strategy-2012-2017.pdf
5	Strategic document	The National department of Health strategic plan for the 2020/21 - 2024/25 period.	60	https://www.health.gov.za/wp-content/uploads/2020/11/depthealthstrategicplanfinal2020-21to2024-25-1.pdf
6	Strategic document	National Digital Health Strategy for South Africa for the 2019-2024 period.	36	https://www.bhfglobal.com/wp-content/uploads/downloads/news/national%20digital%20health%20strategy%20for%20south%20africa%202019-2024a.pdf
7	Strategic document	The South African National Health Insurance Bill [B 11—2019]	60	https://www.gov.za/sites/default/files/gcis_document/201908/national-health-insurance-bill-b-11-2019.pdf

#	Type of document	Description	Quantity (pages)	
8	Annual performance report	The Department of Health annual performance report on the strategic objectives. For the year 2017/2018	216	https://www.gov.za/documents/department-health-annual-report-20172018-1-oct-2018-0000
9	Annual performance report	The Department of Health annual performance report on the strategic objectives. For the year 2018/2019	202	https://www.gov.za/documents/department-health-annual-report-20182019-11-nov-2019-0000
10	Progress report	A 12-month progress report on the status of NHI Pilot districts- May 2015	44	https://ndoh.dhmis.org/owncloud/index.php/s/R5cmdp0gY4Fa43Z/download?path=%2FNHI&files=NHI%20Pilot%20District%20Assessment%202015-%20FINAL.pdf
11	Evaluation report	Report on the evaluation of the implementation of NHI pilot districts in South Africa-July 2019	192	https://www.hst.org.za/publications/NonHST%20Publications/nhi_evaluation_report_final_14%2007%202019.pdf
12	Technical report	The NHI coverage for south Africa (The What, Who, Why and How of the National Health Insurance)	97	https://www.mm3admin.co.za/documents/docmanager/f447b607-3c8f-4eb7-8da4-11bca747079f/00090702.pdf
13	Newspaper article	"NHI pilot projects reveal deep problems" a report on the assessment of the pilot project for the period of 2012 - 2017	5	https://www.businesslive.co.za/bd/national/2019-07-28-nhi-pilot-projects-reveal-deep-problems
Total			1185	

This table (Table 3.1) is detailed in Chapter 4, including the coding of the documents, enabling ease of referencing for analysis, as presented in Chapter 5.

3.7. Data analysis

Data analysis is the last section of the research methodology process. Neale (2016), defines data analysis as a process of identifying, examining, and interpreting collected data to find the meaning and usefulness of it. In this study, the interpretivist approach was used to analyse the data in the form of documents presented in Table 3.1.

The data analysis process was guided by the ANT's four moments of translation which are problematisation, interessment, enrolment, and mobilisation.
The theory was applied as a lens to: -

- Identify and understand the human and non-human factors, including governance involved in the implementation of NHI.
- Examine how networks are formed as the actors (human and non-human) take up roles in the implementation of NHI.

- ❖ Examine the various processes and activities from both technical and non-technical perspectives, in the implementation of NHI, in their heterogeneity.

The analysis process thus enabled a subjective understanding of the technical and non-technical requirements for the implementation of the South African NHI. And, based on the findings of the analysis process, an architecture was developed.

3.7.1. Units of analysis

A unit can be defined as "a single undivided entity or whole" (Chenail, 2012:266). Thus, a study's unit of analysis represents an entity to which the data will be analysed.

Because of the volume of the data, it was important to split the analysis into units. Based on the objectives of the research, that focused on the development of an architecture as stated in chapter 1, technical and non-technical units were most appropriate for the analysis. These two units are further broken down into two sub-sections. This study's units of analysis are illustrated in Table 3.2.

TABLE 3. 2 UNITS OF ANALYSIS

Technical	Non-technical
• Technology infrastructure	• NHI requirements
• healthcare Information Systems	• NHI governance

3.8. Ethical consideration

Good research makes use of consent principles and seeks to minimise the harm and risks to society (Artal, 2017). Due to the sensitive nature of the healthcare environment, ethics was critically essential. Ethics approval to conduct the study was granted by the Research Ethics Committee, Faculty of Informatics and Design of CPUT. Data collection permission was not required as no participants were involved in this research. However, research ethical considerations and code of conduct were ensured in the process of gathering the data. Some of the crucial considerations are as follows:

- Government or healthcare facilities' confidential documents relating to NHI were not accessed.
- All the documents used in the study were accessed from the public domains.

- The documents were solely for the purpose of this study. Thus, the documents were not used for any other purposes.
- In addition, the researcher made sure to avoid manipulating the documents collected or fabricating the process of data collection.

3.9. Conclusion

In this chapter, the research methodology used to meet the objectives of the study was outlined. First, were the philosophical assumptions that underpinned the study? The study employed the qualitative research strategy informed by the interpretivist approach. Articulated in the chapter was the case study research design applied in the study. The case study gave an insight into the NHI and was seen perfectly, as it enabled the researcher to answer the how and why questions of the study in achieving the research objectives. The qualitative data collection and analysis techniques applied in the study were also explained. The data was collected through the document analysis technique and ANT's four moments of translation were used as a lens for the data analysis. Lastly, the chapter presented the ethical issues of the study.

CHAPTER FOUR

CASE STUDY OVERVIEW

4.1. Introduction

Based on the objectives of the study, as stated in Chapter 1, the case selected for this study was NHI. The rationale for the case is articulated in Chapter 3. This chapter thus presents a brief overview of NHI. Firstly, the structure of the case is articulated, which details the actors of the phenomena and their roles. The second section of the chapter presents the detailed collected data in the form of documentation that has been coded for easy referencing. The third section articulates the piloting of the NHI programme, and lastly, the conclusion section provides the summary of the chapter.

4.2. Structure of NHI case

The implementation of the NHI programme is a complicated process that involves a mixed bag of stakeholders. The four main actors of the programme are the government institutions, the public health sector, the private health sector, and the citizens, as presented in Figure 4.1.

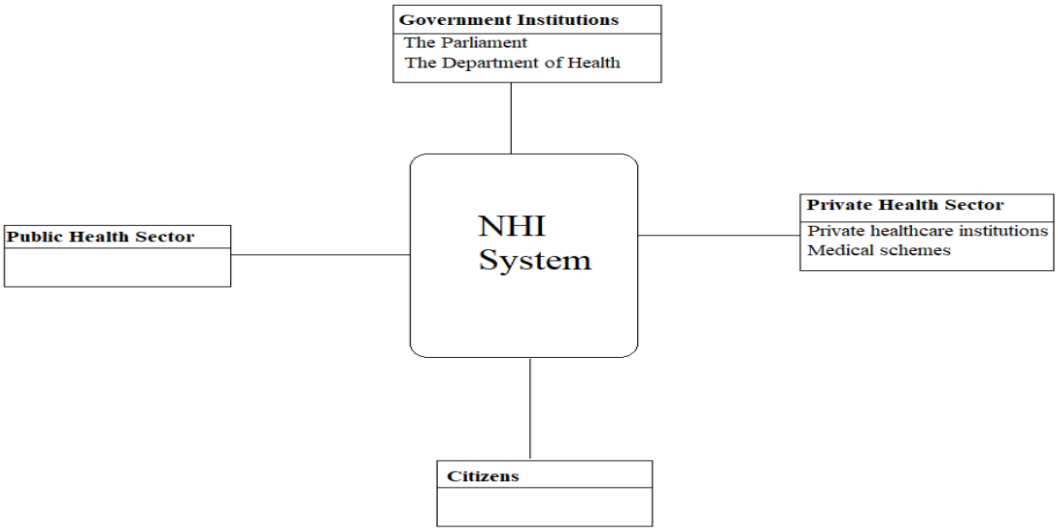

FIGURE 4. 1 ACTORS OF THE SOUTH AFRICAN NHI

4.2.1. Government institutions

In the context of the NHI stakeholders, the South African government, as presented in Figure 4.1, is divided into two sub-sections: The Parliament and the Department of health. The two sub-sections play distinct roles in the process of the implementation of NHI as explained below.

4.2.2. Parliament

The Parliament, also known as the legislature, is the entity that is responsible for making laws in the country. In South Africa, the laws can be made at the three levels of government, namely, national, provincial, and municipality. National entails passing the laws that affect the whole country, the provincial level makes the law affecting the specific provinces, and the municipality level passes the laws for a specific municipality.

The role of the national Parliament as a stakeholder of NHI is to finalize the NHI bill. The development of NHI was a process that involved consultation and consideration of inputs from the stakeholders. Before it got passed as a national law, the green paper for NHI was published in 2011 for public discussion and comment. After considering the comments and contributions from the green paper, the white paper was produced. The bill was then drafted based on the white paper. The NHI was then enacted by the national Parliament and signed by the president in 2019.

4.2.2.1. Department of health

The national department of health is responsible for the development, setting of standards, and coordinating the national health policies. Thus, the department of health is the sole custodian of the NHI policy. The key decision-maker of the NHI fund is a board the minister of health leads. The appointed members of the board constitute the chairperson and the deputy chairperson. The primary responsibility of the board is to advise the minister on the administration of NHI based on the core business processes. These business processes, including the health services delivery and the technological and non-technological infrastructure required, are managed at the provincial level where the national policies can be adapted according to different provincial needs.

The NHI board, through a criterion, is responsible for the process of accrediting and contracting the private and public health providers for the NHI programme.

4.2.3. Public health sector

The South African health system is divided into two sectors, namely, the public and the private. The public health sector is run by the government and citizens pay very little or nothing for their health care needs. The majority of South African citizens access health care services from public health institutions, compared to the private sector, mainly due to affordability. These public healthcare services are distributed and managed in all nine provinces nationwide.

The national healthcare system is divided into three main layers: the primary, secondary, and tertiary health care services. Primary health care services focus on providing the basic health needs such as the promotion, prevention, rehabilitation and curing the patients and citizens. These services are often offered at district health centres, which are normally the initial place where the patients meet with the healthcare providers.

The secondary is the second level of contact, whereby patients from the primary care centres are referred to for special health care services. Secondary health care provides specialist support to several primary care centres and is delivered through regional hospitals.

The highest level of care is tertiary. These consist of provincial hospitals and specialized hospitals which only work on referral systems, as no walk-ins are served at such hospitals except in emergency cases. Provincial hospitals receive referrals from secondary care and they offer services such as plastic surgery, cardiology, neurology, among others. An example of such a hospital is the Steve Biko Academic Hospital in Pretoria, which is a healthcare training institution. Specialised hospitals are those hospitals that provide care to a specific group of people such as those with TB. There are quite a number of these specialised hospitals in the country, and they come in different sizes, according to the number of patients they can accommodate as well as the services they provide. One of the biggest specialised hospitals is the King DinuZulu Hospital Complex in Durban, which provides psychiatric and TB services.

Through the primary care centres, the public health sector is responsible for registering the NHI patients which are citizens of the country. The administration of the referrals both from the accredited health institutions for secondary and tertiary services will be also managed by public health institutions nationwide. All these institutions, thus require information technology infrastructures to enable the enrolment and administration of the NHI programme. The ICT infrastructure thus plays an important role in the implementation of NHI, however, the distribution of these ICT infrastructures at hospitals and clinics across the nation is not balanced.

4.2.4. Private health sector

As shown in Figure 4.1, private healthcare as a stakeholder of NHI is divided into two sub-sections; private health institutions and the medical schemes. The two sub-sections are as discussed below.

4.2.4.1. Private health institutions

Private health institutions comprise surgeries, private hospitals, and pharmacies run by individuals. The citizens can access the private health care services subject to affordability. The payments can be out-of-pocket or by the use of private health insurance such as medical schemes.

Private hospitals and professionals will be contacted by the national department of health to supplement the public health sector in implementing the NHI programme. Thus, the NHI fund will purchase the health care services on behalf of the citizens from the accredited and contracted private health providers. Likewise, the government will accredit and contract some private pharmacies to dispense the subsidised drugs and medicines. This will also aid equitable access to medicines in the country.

Only registered citizens with NHI membership cards may receive health care services for free from these private healthcare providers. Depending on the health care needs, patients can also be referred to public health institutions. The referrals could be for the secondary and or tertiary medical services not rendered by the private health institutions under the NHI programme.

4.2.4.2. Medical schemes

Medical schemes pool their member's contributions and provide funding for private healthcare services. According to the NHI bill, once the NHI is fully implemented, these medical schemes will only provide complementary cover. Otherwise, the services will be covered by private medical schemes or out-of-pocket payments. The foreign nationals without permanent residency may not be covered by NHI and will have to make use of their medical schemes to access healthcare services.

4.2.5. Citizens

The current South African health system is a two-tiered system that is based on socio-economic status and it lacks equity. The inequality shapes the divide between the private and the public healthcare sectors. The aim of the NHI programme as articulated in Chapter 1 is to bridge this gap in the healthcare system by enabling universal access to quality health care services to all South African citizens disregarding their socio-economic status.

Thus, the main beneficiaries of the NHI programme are the citizens of the country. NHI membership will be mandatory; thus, the citizens will have to register to benefit from the fund. The registered citizens will receive an NHI card to access health care services for free, from the accredited private or public health institutions close to where they live. However, if citizens choose to use their healthcare institutions that are not contracted by NHI, do not follow the NHI pathways, or seek services not reimbursable by the NHI, they will have to either pay for their healthcare needs out- of- pockets or get funded by their medical schemes.

4.3. Fieldwork

The qualitative data about the NHI was collected using documentation. The technique was chosen primarily because, at the time of this study, the phenomenon was new and being piloted in phases. Thus, no empirical evidence on the full implementation could be obtained through other data collection techniques such as interviews.

The documents were collected electronically from the department of health's website. These documents were obtained from the public domains; hence, the researcher did not seek data collection permission. The documents were selected using some criteria as stated in Chapter 3.

As shown in Table 4.1, a total of 13 documents constituting four strategic documents, two government gazettes, two annual performance reports, a policy paper, a progress report, an evaluation report, a technical report, and a newspaper article were collected. For easy referencing during analysis, the documents were coded according to type. For example, code GG_01; GG refers to the type of document which is a government gazette, and the 01 represents the first gazette, that is the proposed National Health policy, with the last column representing the total number of pages of the document. Thus, a document coded GG-02 simply means the second gazette document with a different description as shown in Table 4.1.

TABLE 4. 1DATA COLLECTED

Type of document	Code	Description	Number of pages
Government Gazette	GG-01	The proposed National Health Insurance policy notice. The notice was gazetted on the 11th of December 2015.	98
	GG-02	White paper on the National Health Insurance. The document was gazetted on the 30th of June 2017.	80
NHI Policy Paper	PP-01	The final policy document for the South Africa NHI.	59
National Health Strategic Document	SD-01	The document on the national eHealth Strategy, for South Africa for the period of 2012/13-2016/17	36
	SD-02	The strategic document on the National department of Health's plan for the 2020/21 to 2024/25 period.	60
	SD-03	The South African National Digital Health Strategy document for the 2019 to 2024 period.	36
	SD-04	An explanatory summary of the South African National Health Insurance Bill [B 11—2019]	60
The Department of Health Annual Performance Report	AP-01	The Department of Health's annual performance report on the strategic objectives for the year 2017/2018.	216
	AP-02	The Department of Health's annual performance report on the strategic objectives for the year 2018/2019.	202
Progress report on the status of NHI Pilot districts	PR-01	The third 12-month report on the rapid assessment of the implementation status of NHI piloted in the districts. The report covers the February 2014 to February 2015 progress.	44
Evaluation report on NHI pilot districts	ER-01	A report on the evaluation of the phase one implementation of NHI pilot districts. The evaluation was undertaken between November 2017 and December 2018 and published in July 2019.	192
Technical report on NHI	TR-01	A report on the coverage of NHI in the country. The report answers the "What, Who, Why and How" of the National Health Insurance programme.	97
Newspaper article	NA-01	An article on the assessment of the pilot project for the period of 2012 - 2017	5
Total			**1185**

4.4. The NHI pilots

The implementation of the NHI system was scheduled in three phases. The first phase ran from 2012 to 2017, the second phase, which is currently taking place, was scheduled for the years 2017/2018 to 2021/2022, and lastly, phase three to be rolled out in the year 2022/2023 until 2025/2026. As explained below, each phase has a distinct focus.

The first phase of the NHI implementation included the piloting of various interventions in the selected districts countrywide. The districts were selected using some criteria, including the burden of diseases, location, population, and the performance of the district, among other factors. The three districts are from the KwaZulu-Natal province, and one district from each of the eight provinces, to make a total of eleven districts across the country.

As presented in Table 4.2, these sites provide the name of the pilot districts per province and the statistical information in the context of the population per district. The significance of the population is to give an estimation to understand the number of people who can be registered for NHI at the district level. The piloting in phase one was mainly for preparing, strengthening, and testing health systems before the full implementation of the NHI system. Thus, the information in Table 4.2 will be used to assess the type of infrastructure and its use in implementing the NHI programme.

TABLE 4. 2 NHI PILOT DISTRICTS (EXTRACTED FROM THE EVALUATION REPORT ON NHI PILOT DISTRICTS DOCUMENT)

Province	District	District Population (2012)
Eastern Cape	OR Tambo	1 754 499
Free State	Thabo Mofutsanyana	771 610
Gauteng	Tshwane	2 520 435
KwaZulu-Natal	Amajuba	517 279
	uMgungundlovu	1 071 606
	uMzinyathi	517 806
Limpopo	Vhembe	1 312 197
Mpumalanga	Gert Sibande	946 719
Northern Cape	Pixley ka Seme	192 572
North West	Kenneth Kaunda	905 675

Western Cape	Eden	567 993
Total		**11 078 392**

The main focus of Phase 2 is the development of the NHI legislation and amendments to other legislation, as well as the establishment of the NHI fund institutions. Phase 3 involves healthcare services contracting of accredited private doctors, specialists, and private hospitals to supplement the public sector delivery system.

4.5. Conclusion

This chapter provided the background of the case study, which was NHI. It also articulated the main actors of NHI, comprised of the government, the citizens, the public and private health institutions, and their roles. It also presented a brief overview of the fieldwork and detailed documentation of the data collected with the coding for easy referencing. Lastly, the chapter discussed the phased implementation approach of NHI, providing information about the pilot districts in the country, and their population per district. This was provided to give a general idea of the planning of pilot NHI programme in the context of required infrastructure.

CHAPTER FIVE

DATA ANALYSIS AND FINDINGS

5.1. Introduction

This chapter presents the data analysis conducted using the actor-network theory (ANT), as explained in Chapter 3. The theory is discussed in Chapter 2. The analysis was conducted to achieve the study's objectives, as stated in Chapter 1 and revisited in Chapter 3 and the following section. This is towards achieving the aim of the study, which is to develop a technical architecture framework that can guide the implementation of the South African national health insurance (NHI) from the technology perspective. The chapter is divided into five main sections. Firstly, the chapter provides an overview of the data analysis process in the first section. The second section presents the data analysis process conducted using four moments of translation from the perspective of ANT. The findings from the analysis are interpreted in the third section of the chapter. The fourth section presents the architectural framework for the implementation of the NHI. Lastly, the chapter is concluded.

5.2. Overview of data analysis

Data analysis is a process of identifying, examining, and interpreting collected data to find its meaning and usefulness (Neale, 2016). Thus, data analysis was done to achieve the objectives of the study. As explained in Chapters 3 and 4, the case study approach was followed in this study. The data was collected using the document analysis technique, as discussed in Chapter 3, based on which the 13 most relevant documents were gathered. For ease of referencing during the data analysis process, the thirteen collected documents were provided with unique identification, meaning codenames were assigned, including the number of each documentation. This process helps to define referencing standards adopted for analysis purposes. An example of the referencing standard is “GG_01, pg.35”: the GG refers to government gazetted document; 01 represents the document’s number, and pg.35 is the document's page number. Thus, GG_01, pg.35, means page 35 of the first government gazette. Table 4.1 in Chapter 4 presents detailed information about documentation and their unique identification codes.

This study's two main objectives, as explained in chapter one, were to:

i) Examine the factors (such as process, governance, and legislature) that can influence the implementation of the South African NHI
ii) Examine the technology infrastructures, information exchange, and business requirements for implementing the South African NHI.

To achieve the stated objectives, the analysis process was conducted from the interpretivist perspective. As mentioned above, the ANT's four moments of translation were used as a lens to guide the analysis. The data analysis process is presented in the following section. Based on the objectives, the focus of the analysis was threefold: (1) Examine how networks are formed as the actors (human and non-human) take up roles in the implementation of NHI; (2) Identify and understand the human and non-human factors, including governance involved in the implementation of NHI; and (3) Examine the various processes and activities from both technical and non-technical perspectives in implementing NHI in their heterogeneity.

5.3. Data analysis

The analysis began with identifying the various existing actors and networks in implementing the NHI in South Africa. After that, moments of translation are employed to follow the actors in their constantly shifting negotiations to get things done in the implementation of the NHI.

5.3.1. Actors

In the context of ANT, actors refer to human and non-human entities that can make a difference (Shim & Shin, 2016). The NHI consists of a variety of actors, as shown in Figure 5.1. The implementation of NHI is a process that involves different humans (professionals and non-professional) who undertake different roles using non-human (such as technologies and processes) as a means to achieve various results and ends. These actors are visually represented in Figure 5.1.

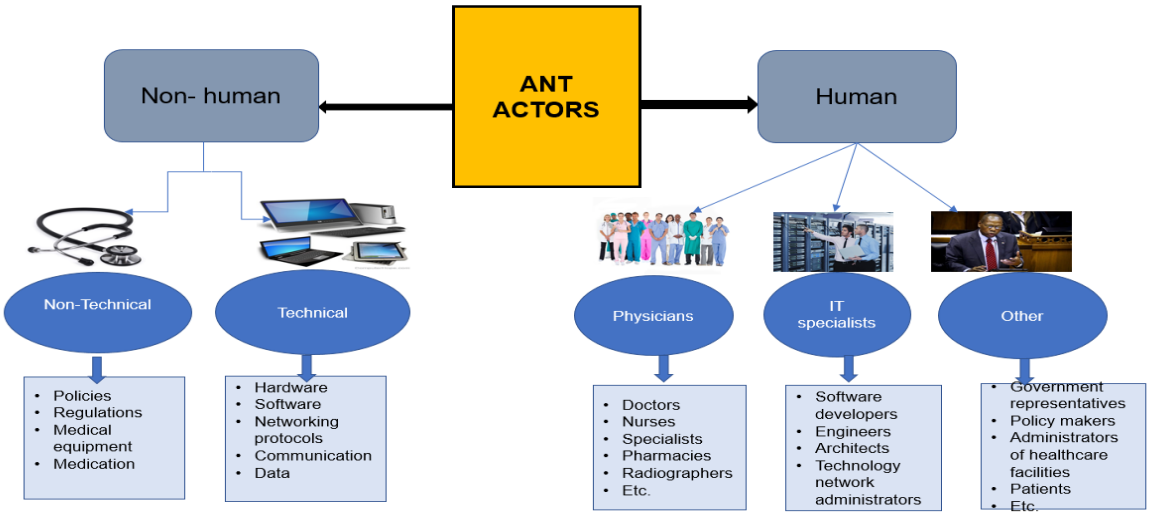

FIGURE 5. 1 ACTORS OF NHI

5.3.2. Human actors

As represented in Figure 5.1, at the time of this study, the human actors involved in implementing the NHI system were in three main categories: physicians, information technology (IT) specialists, and others. The physicians include medical doctors, dentists, pharmacists, radiographers, and other healthcare professionals. Expectedly, the actors were employers and employees in both the country's private and public healthcare institutions. The IT specialists were diverse, from software developers to engineers, architects, and technology network administrators. The IT specialists were employed by both public and private healthcare institutions. Other actors are a large group that consists of individuals with various professional backgrounds. This group included policymakers of health-related activities, healthcare facilities administrators, and medical aid companies' managers. Also included in this group were patients and government representatives. These human actors are expected to play different roles in providing healthcare services to patients using the NHI system.

Thus, the implementation of the NHI system critically requires the input of these human actors. For example, the IT specialists are expected to enable and support the NHI system, and the physicians and other actors are considered the primary users of the system in both private and public healthcare institutions in the country. In one of the strategic documents, it is stated as follows:

"To ensure equitable access to medicines and related pharmaceutical products, NHI will accredit and contract with private retail pharmacies based on need" (GG-01, pg. 36).

The criticality of IT solutions lies in the roles undertaken by the IT specialists in the implementation of the NHI, which includes software (system) development, installation of systems, support and management of the NHI, and other related IT solutions such as the integration of health information systems (HIS) and health computer-based programmes. One of the reasons that make the HIS crucial is because it is implemented and used at the three main governance levels. It commences from the local or district level and feeds into the provincial and national levels, which helps determine and refine the NHI system requirements.

Consequently, there is a need for collaboration between the actors. For example, IT specialists do not determine or formulate functional (related) requirements. However, without IT specialists, the requirements cannot be enabled and supported. Similarly, without a good understanding, user-friendliness, and stability of the NHI system, the users will be challenged in using it, leading to its termination. This collaboration of stakeholders is emphasised in one of the strategic documents as:

"*… In health information practices, a shift is required from simply collecting data for reporting, to a deeper engagement with the information and the people involved with it, to building collaborative arrangements to extract meaning and find innovative responses. Effective stakeholder engagement is a requirement for success and establishes the key role players and participation for implementation" (SD-03, pg. 20).*

On the other hand, as shown in Figure 5.1, the government professionals comprised the health minister and team, the NHI advisory committee members, and the legislative body members. These actors, through the three levels of governance, collaborated to drive the NHI policy. The main role was formulating and passing the health policies and the accrediting and contracting of the healthcare providers to the NHI system.

5.3.3. Non-human actors

During this study, the non-human actors involved in implementing the NHI varied from the health infrastructures to processes and IT solutions. Through processes, the human actors applied available infrastructure and IT solutions in the various stages of implementing the NHI system. In

understanding the factors that can influence a technical architecture, the non-human actors were divided into technical and non-technical, as shown in Figure 5.1.

Technical actors

Technical actors of the NHI system constituted the IT solutions utilised by the human actors. This includes the IT requirements, hardware, software, network protocols, communication, and data. Inevitably, these IT solutions can be used to enable, support, integrate, and manage HIS in both private and public healthcare facilities for service delivery. A variety of HIS was deployed in the public sector, including; Delta 9, Medicom, Meditech, PALS, Pro-Clin, ReMed Soarian MedSuite, PharmAssist, PAAB Clinicom, PHCIS, and JAC Pharmacy. However, concerns were raised on the issue of the existence of these disparate systems. These concerns were expressed in one of the eHealth strategic documents as follows:

> *"…. besides being implemented on different platforms and databases, these systems vary widely in their architecture, impact on workflows, usability and support structures. The systems are unable to communicate with each other (there is no interoperability), and they do not communicate with a National PMI" (SD-01, pg. 14).*

These IT solutions were also required to register patients using the Health Patient Registration System (HPRS), at the point of care, which was one of the pre-requisites for the NHI system at the time of this study. However, during the first phase of NHI implementation, it was noted that the HPRS had challenges of lacking integration with other systems. This observation was explained in one of the reports as:

> *"…there have been challenges associated with the lack of integration between HPRS and other e-health interventions such as MomConnect and the Stock Visibility System (SVS), as well as with the WBPHCOTs, who do not have access to HPRS yet and are often the first point of contact with patients" (ER-01, pg. 97).*

Another technical actor that played a vital role was internet connectivity, which was utilised not only for communication but also to support some systems such as the SVS. This was expressed in one of the reports on the evaluation of the piloting programme as follows:

> *"The stock visibility system, which monitors medicine stock levels at clinics and hospitals from Pretoria to prevent shortages, was affected by a lack of internet connectivity" (NA-1, pg. 4).*

Computers were also used for communication at the healthcare centres, both internally and externally. Referrals of patients and or patients' data from the PHC facilities either by private or public providers to higher levels of care or specialists used communication channels supported by computers.

Non-technical actors

Another category of non-human actors of NHI was the non-technical actors. These constituted all the medical infrastructure, such as the buildings and medical equipment used by the medical actors to carry out their roles in providing care to the patients. The importance of such infrastructure is described as follows:

> *"...infrastructure is a key contributor for health systems strengthening and agree that the success of the intervention is influenced by the existence of an enabling environment" (ER-01, pg. 105).*

Other non-technical actors that played critical roles were the medical processes, the medication given to the patients, and the health policy documentation that guided the activities and procedures of the NHI system. These non-technical actors were equally important in implementing the NHI system and were treated the same as human actors in the context of ANT.

5.3.2 Actor-network

In ANT, a network consists of a group of actors with common goals and interests (Iyamu, 2013). Also, networks can exist within a network, referred to as heterogeneity (or heterogeneous networks) (Callon, 1984). In the implementation of the NHI, there exist many networks from (1) private and public healthcare institutions, (2) health practitioners and IT specialists' professions, and (3) citizens and government's perspectives. Some of the networks came into existence intentionally. Others were a result of unintended actions as different actors came together in the process of implementing. Others were a result of unintended actions as different actors came together to implement the NHI system.

Private and public healthcare institutions

Several networks exist from the private and public healthcare institutions perspective. These networks include the collaboration of both the institutions, which came about through the NHI referral system whereby the patients are referred from either private to public or public to private

healthcare institutions, based on their healthcare needs. The network formed through the referral process is described in one of the documents as follows:

> *"…patients cannot go straight to a specialist or a hospital without being seen at the PHC level, be it at a clinic or a general practitioner…" (GG-01, pg. 34).*

Besides the networks formed through referrals, there are networks in both private and public institutions with different health requirements, which are enabled and supported by different HIS.

A private health institution is a network constituting an actor who offers private healthcare services to the citizens subject to affordability. These networks also consist of sub-networks of actors with common interests and roles in providing healthcare service to patients. Examples of these networks include groups of medical doctors, radiographers, specialists, pharmacists, nurses, and other administrative staff at a private health institution. These private healthcare institutions constitute the surgeries, private hospitals, and pharmacies accredited to implement the NHI system.

Likewise, a variety of networks were formed in the public healthcare institutions during the implementation of the NHI system. Public healthcare institutions, commonly known as national healthcare facilities, are a heterogeneous network of healthcare institutions run by the government to serve the majority of the population. Based on the level of care provided, there are three main sub-networks in these public healthcare institutions: primary, secondary, and tertiary health care services. In addition, each of these sub-networks consists of sub-networks of actors constituting non-medical and medical actors. The non-medical network consists of the IT specialists involved in the deployment and maintenance of the HIS, which is a critical aspect of implementing the NHI system. On the other hand, the medical networks include physicians such as nurses, doctors, dentists, paediatricians, among others, with distinct roles in the provision of healthcare and the implementation of NHI at the different levels of care.

Citizens and government

The phased implementation of the NHI system resulted in the creation of heterogeneous networks from the government perspective. These include networks from the parliament and the department of health who worked together to formulate the relevant health and NHI policies. As the sole custodian of the NHI system, a group of actors from the department of health and the NHI advisory committee led by the health minister developed the NHI policy. The parliament

network also played a key role in enacting the NHI bill. This network consists of legislative body members sub-networks from the three levels of governance, namely the municipality, provincial and national, which all played distinct roles in passing the NHI as national law.

Another category of the NHI network was from the citizens' perspective. There were distinctive sub-networks of citizens that existed, and these are categorised in the context of illness; registered NHI beneficiaries (the system already), citizens seeking the healthcare service under the NHI system for the first time (unregistered), the citizens not eligible to be the beneficiaries of the NHI system; those eligible but opting not to be part of the NHI system (use private medical schemes), among others.

Health practitioners and IT specialists' professions

Networks in the context of the health professionals consist of all the healthcare workers serving in both the public and private healthcare institutions involved in implementing the NHI system. These include groups of physicians such as doctors, nurses, administration clerks, pharmaceutical staff, and healthcare specialists, among others with aligned interests, primarily to provide the needed healthcare service to the patients under the NHI system.

During the implementation of the NHI system, several networks also came into existence from the IT specialists' professional perspective. Different networks were formed based on the roles played by the different IT specialists in enabling the NHI system across the country. These include networks of software developers, architects, engineers, network administrators, hardware technicians, IT support personnel, data capturers, among others. Most of these networks of IT specialists were deployed at all three levels of governance or care, which are the district level, provincial and national level, playing their distinct roles in implementing the NHI system.

5.3.3 Moments of translation

In ANT, translation is a concept through which the focal actor builds networks, recruits actors and defines roles by constantly shifting negotiation (Elbanna, 2011; Callon, 1984). As highlighted and explained in chapters 1 and 2, there are four main moments in translation: problematisation, interessment, enrolment, and mobilisation networks (Iyamu, 2013; Callon, 1984).

The activities of the NHI are consciously and sometimes unconsciously carried out in the process of deployment. Thus, it has been difficult for some factors, attributes, or characteristics to be

identified or appropriately understood. Thus, the activities involved in deploying the NHI are analysed, using the four moments of translation as a lens. The analysis is first summarised in Table 5.1. After that, the analysis is presented. Therefore, the table should be read with the discussion to better understand how activities manifested in NHI deployment in the country.

TABLE 5. 1 MOMENTS OF TRANSLATION

Problematisation	Interessement
From the IT perspective, the NHI is problematised at two main levels. Firstly, through its minister, the department of health problematised the NHI, purposely to attain universal health coverage (UHC) in the country. Secondly, the NHI is problematised for enablement and support of the IT, which require strategic and operationalisation of a technical architecture framework.	There are many interested parties, referred to as stakeholders (actors), in the deployment of the NHI. Although these stakeholders' interests are geared toward a common goal, deployment of the NHI, how the interest came to varies. There are two main groups of stakeholders, those related to healthcare and enablers (IT specialists). Also, the interests are either voluntarily or compared (contractual) by the constitution or law of medical association.
Mobilisation	Enrolment
In the strategic and operationalisation of the NHI, there exist spokespersons from various angles and different levels. The Minister of Health speaks on behalf of the government, and the IT specialists provide guidance (speak) on technology solutions for the NHI implementation. Mobilisation is also being experienced by healthcare institutions customising the NHI system with their current solutions.	However, not all the stakeholders that have shown interest in the deployment of NHI participate in the ongoing actualisation of the solution (NHI system). By default, the policymakers participated in the program as they formulated the necessary health and NHI policies that guided the implementation of the system. Based on the policies and

	requirements, the IT specialists provided IT solutions for enablement and support.

Problematisation

Problematisation is the first moment of the translation process. This moment is whereby the main actor identifies the problem or an issue to be solved (Iyamu, 2013). In this study, the implementation of the NHI was problematised from two different perspectives: (1) the South African government problematised the need to attain universal health coverage (UHC) in the country through the department of health; and (2) the use of IT solutions to enable and support the NHI, including integrating related healthcare systems, was also problematised. The latter is based on the former. Also, the focus of this study is on IT solutions related (technical architecture). The implementation of the South African NHI system was one of the key strategies to achieve UHC. The NHI fund intended to bridge the gap in the healthcare system by pooling the funds to provide the needed health care services to the patients based on need and not affordability. This measure was expressed in one of the documents as:

> *"The implementation is underpinned by Vision 2030 of the National Development Plan (NDP), which envisions that by 2030, everyone must have access to an equal standard of care, regardless of their income, and that a common Fund should enable equitable access to healthcare, regardless of what people can afford or how frequently they need to use a service" (GG-02, pg. 13).*

The problematisation of the NHI by the government followed several steps. Firstly, the initial development and implementation of the NHI system was supported by policies and laws. Secondly, it was the NHI green paper, published in 2012 for contributions and comments from the public. Thirdly, the feedback and contributions on the green paper were used to develop the white paper for the NHI policy to guide phase-one implementation of the NHI system later enacted into law by the national parliament.

This process of problematisation happened at the three main levels of government, local, provincial, and national. Also, this means that it cuts across the various geographical locations of the country to increase buy-in through widespread, sufficient, and accurate information disseminated to the citizens and other stakeholders such as the healthcare practitioners. This happened through the piloting of the NHI system. The eleven piloting district sites (with at least a

site per province) were selected demographically, and the socio-economic status, the burden of diseases, were considered in the criteria. It is stated in one of the NHI gazetted documents as follows:

> *"In preparing the ground for NHI, there is a clear imperative to improve the administration and effectiveness of public health delivery, to draw on lessons of current practice and to pilot innovative approaches to partnering between public and private service providers" (GG-02, pg. 52).*

The piloting programme thus increased the stakeholders' levels of understanding and awareness of the NHI implementation plans and vision as they participated. In addition, this first phase of piloting the NHI system was mainly for preparing, strengthening, and testing the public health systems before the full implementation of the system.

From IT solutions' perspective, the NHI was problematised by IT personnel in the government. This action was done to both IT specialists and non-IT specialists, including healthcare practitioners, citizens, and government agencies, to ensure the gathering of comprehensive requirements, which determine the IT solutions that will be provided to enable and support the strategic operations of the NHI. To the IT specialists, problematisation was intended to explain the NHI in enabling and supporting the healthcare solutions. Thus, some of the IT specialists involved were software developers, network administrators and managers, and IT infrastructure managers. One of the essentialities of the IT solutions in the implementation of the NHI system is as explained below:

> *"The NHI Fund's information system will be based on an electronic platform, with linkages between the NHI Fund membership database and the accredited and contracted health care providers. The information system will be crucial for implementing the NHI and the portability of services for the population" (GG-01, pg. 80).*

Although the problematisation of the NHI from both the technology and healthcare fronts was done through different means like media and government gazette, they were all documented. Thus, how the documents were shared, stored, and managed became the most important aspect of problematisation. Primarily, actors' roles and responsibilities, including NHI's rationale and requirements, are contained in the various documents, which remain reference points as the implementation of the solution progresses. The actors' roles range from providing healthcare

services to any other support needed in the healthcare processes, such as administrative duties. The main actors are shown in Figure 5.1, including human actors such as citizens, physicians, and IT specialists, and the non-human actors varying from the health infrastructures to processes and IT solutions.

Interessement

From the existing documents, the implementation of the South African NHI system is of interest to the stakeholders, which include citizens, healthcare providers (practitioners and managers), sponsors (government), and IT specialists. These stakeholders' interests were, however, driven by different factors. In the NHI system, citizens constituted the key stakeholders as one of the beneficiaries of the system. Primarily, many citizens are interested in quality healthcare at no cost or reduced cost at the point of care. Also, many South Africans are interested in the NHI concept because it is expected to extend to the country's rural areas.

As the sole custodian of the NHI fund, the interest of the department of health was the formulation of the health policies, including the NHI policy, and the governance of all the required resources. The other crucial information contained in these policies includes the NHI's rationale and requirements and the roles and responsibilities of the involved actors. Thus, the interest in formulating these policies are to mitigate challenges in the implementation process, as each actor or stakeholder involved in the process would know their roles and responsibilities.

Other actors interested in implementing NHI were the physicians from both private and public healthcare institutions at different levels of health services. These include all the medical staff such as nurses, doctors, administration staff, and pharmacists with distinct roles in providing the healthcare service per the patients' needs. The laws of medical associations guided the physicians as they participated in formulating and stipulating the healthcare processes and requirements for implementing the NHI system.

The interest of the IT specialists is mandatory, as they are responsible for developing IT solutions for the enablement and support of the NHI system. It is through IT solutions that the NHI system can be implemented across the country. The criticality of the IT solutions is explained in one of the strategic documents as:

> *".. the national Department of Health shall facilitate and coordinate the establishment, implementation and maintenance of the information systems by provincial*

departments, district health councils, municipalities and the private health sector at national, provincial and local levels in order to create a comprehensive national health information system" (SD-03, pg.15).

Thus, as the enablers of the NHI system, the IT specialists are interested in providing the needed IT solutions (based on the given health requirements) for the implementation of the NHI system. The interested IT specialists include the IT managers, software developers, network administrators and managers, and IT infrastructure managers playing different roles in enabling and supporting the required IT solutions.

Also, the IT specialists were interested in providing sustainable, less complex integration with other HIS systems and flexible solutions that enable the NHI across the country. Such interest is driven by professionalism and national interest. There is bound to be personal interest, including know-how in selecting and deploying technologies to enable and support the NHI. Some IT specialists are skilled in one or two areas, not in all technology solutions. This is fundamental to the success or failure of IT in achieving its goal and objectives. Thus, the selection of IT solutions must be based on governance, including policies, standards, and principles.

However, not all the stakeholders that have shown interest in the deployment of NHI participate in the ongoing actualisation of the solution (NHI system). An example is the private medical schemes, whose role outside the NHI system was explained as follows:

"Once NHI is fully implemented, medical schemes will offer complimentary cover to fill gaps in the universal entitlements offered by the State" (GG-01, pg. 89).

According to the NHI constitution, some of the actors were not assigned any roles in the implementation s of the NHI system at the time of the study, regardless of their interests.

Enrolment

Enrolment is the third stage of translation. At this stage, different actors accept the roles proposed by the focal actor (or actors) and jointly find a solution to the problematised item or entity (Waeraas & Nielsen, 2016), meaning that roles and responsibilities were assigned to interested human actors by the focal actor. However, not all interested actors participated in implementing NHI in the country during this study. The actors' participation was guided and influenced by their interests. Participation of human actors was from both technical and non-technical angles.

Participation from the non-technical front entailed the gathering of requirements from citizens (patients), healthcare (or medical), and legislative (government) perspectives. These tasks were allocated to people with know-how and capability. From the legislative perspective, participation entailed enacting NHI and health policies used to guide the implementation process by the parliament. According to the NHI policies, an example of the NHI requirements is the mandatory registration of the patients for care. This registration was explained in one of the NHI reports as follows:

> *".. the health patient registration system was rolled out to capture patient details on a computer system. By the end of 2018, 20-million people were registered. But poor connectivity, hardware problems and a lack of IT staff meant some clinics were unable to connect to the internet" (NA-01, pg. 3).*

Patients' participation was through their interaction with the physicians during the registration process. This interaction was done at the point of care, seeking healthcare, and receiving the needed healthcare service from the physicians. The healthcare stakeholders participated in implementing the NHI system because of their critical roles in determining the functional requirements of the NHI system. Thus, the IT specialists developed the IT solutions for the enablement of the NHI system through the requirements from the various physicians. In addition, these physicians participated in implementing the NHI system as they provided the needed healthcare to the patients.

Those who participated from the technical viewpoint included software developers, network administrators and managers, IT managers, and systems analysts. The IT managers ensured that relevant IT solutions were developed and implemented as they executed their management duties. The systems analysts' role includes applying their expertise to bridge the gap between the technical and non-technical stakeholders of the NHI system. The systems analysts engaged with non-technical actors, including the medical, government, and citizens, to gather the requirements. The software developers used these requirements to develop IT solutions such as the HPRS, which was being used for the mandatory patients' registration process at the time of the study. The system was used to capture the patients' details as they registered to become the beneficiaries of the NHI system.

On the other hand, network administrators and managers are responsible for coordinating and managing the computer networks across healthcare facilities. The implementation of NHI requires communicating and sharing data and information among the private and public healthcare institutions' stakeholders. At the time of the study, different IT solutions were being used across these institutions. Thus, the major role of the network administrators was to enable the connection and coordination of the IT resources both internally and externally, enabling the sharing and integration of the patients' data and information among the NHI stakeholders.

Mobilisation

Mobilisation entails communicating the interests and roles of actors and the formed network by the spokespersons or the representatives of that network (Shim & Shin, 2016). During the implementation of the NHI system, mobilisation took place from the government, IT specialists' and healthcare institutions' perspectives at different levels. Representatives played fundamental roles in negotiating and communicating the actors' roles in their respective sub-networks to ensure the implementation of the NHI system.

On behalf of the South African government, the health minister became the focal actor of the NHI system. They mobilised the strategic operationalisation of the NHI system in several ways. Firstly, they accredited and enforced the participation of the private and public healthcare physicians and other stakeholders. Also, they provided constant feedback and updates on the progress of the phased implementation of NHI and encouraged the stakeholders in the NHI network. Mobilisation also occurred at the district levels through the district health managers and the respective facility managers at the NHI pilot centres. These managers played the representative roles of managing and mobilising the healthcare activities at the designated centres, ensuring the customised implementation of the NHI system using the available IT solutions. This was done by mobilising the communities and enforcing the smooth registration of the patients on the HPRS. This engagement with the community is explained as follows:

> *"...HPRS has been communicated to communities through open days to inform them of the new system and the need for them to bring their identity documents when visiting a healthcare facility so that they can be registered. These efforts have created a sense of ownership among the implementers and, in doing so, have generated buy-in at all" (ER-01, pg. 96).*

Such direct communication channels at specific sites benefit the overall success of the implementation process as it requires a collaboration of stakeholders.

From the Technology perspective, the mobilisation was done by providing the IT solutions and resources required to implement the system. The IT managers mobilised their IT specialists as they provided the IT solution. The joint effort of a team consisting of software developers, network administrators and managers, and systems analysts resulted in the development and deployment of the various HIS being utilised by healthcare institutions at the time of the study to customise the implementation of the NHI system across the country.

5.4. Findings and Interpretation

Based on the analysis of the data presented in the previous section, 6 key factors influenced the implementation of the South African NHI: (1) readiness assessment; (2), Government levels of health services; (3) Geographical locations of stakeholders; (4) Diversity of healthcare facilities; (5) Flexibility of technology solutions; and Synchronisation of processes and patients' data. As shown in Figure 5.2, the factors are connected. Thus, the figure should be read with the following discussion to understand better how the factors influence the implementation of the NHI in the country.

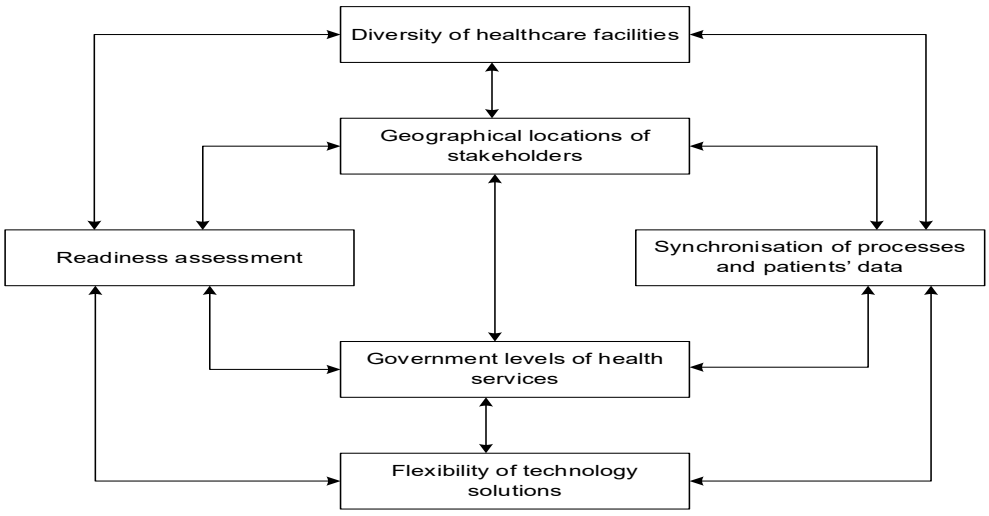

FIGURE 5. 2 FACTORS INFLUENCING NHI IMPLEMENTATION

5.4.1 Readiness Assessment

Readiness Assessment is the systematic analysis conducted by an organisation before adopting or implementing a technology solution. The process increases the organisation's level of readiness as gaps can be identified and addressed, thus reducing the risks of the implementation project's failure (Kirmizi & Kocaoglu, 2020). IT solutions enable the NHI system. Thus, readiness assessment in the context of the NHI system's implementation entails assessing the health environment technologically to mitigate the potential technical infrastructure challenges in the implementation process.

The South African health environment is diverse. According to the analysis conducted, there seems to be no readiness assessment conducted in technology. The public and private healthcare institutions operate on different IT solutions, making synchronising patients' data and consolidating technologies impossible. The health department manages the procurement process of the IT infrastructure for the public healthcare institutions, using standards and principles different from the private institutions. However, the implementation thereof is decentralised at primary and secondary levels while governed by a set of policies. Hence, the existence and utilisation of disjointed IT solutions at different public and private healthcare institutions are non-compatible.

The analysis showed that healthcare institutions from both private and the public across the country were still operating at different phases regarding technology usage. Some health facilities were transitioning from paper-based to electronic, while others maintained both paper-based and electronic records. Thus, if a readiness assessment process had been done, the challenges such as interoperability and integration of healthcare IT solutions and internet connectivity issues faced during the phase one implementation of the NHI system would have been mitigated through the application of technical architecture in the development of the IT solution.

5.4.2 Government levels of health services

The analysis reveals three government levels of healthcare services, namely, primary, secondary, and tertiary. These levels are classified based on the type or level of healthcare they offer. The primary level is the first point of care where patients are expected to contact when they need healthcare services. As the first point, the registration of patients and their details were carried

out. Examples of primary level are clinics, general practitioners, commonly referred to as GP, and district hospitals. The secondary level is the second tier of health service, where the primary level healthcare facility refers patients. Examples of secondary level are the hospitals offering specialised care, such as urology and cardiology. The third level is tertiary, which offers more advanced and specialised healthcare services such as cardiac surgery and is only accessed through a referral system from the secondary level.

These different levels of health services use different customised IT solutions to operationalise the healthcare service. As revealed in the analysis, the uniqueness of the health facilities makes it highly possible to have differentiation in the IT solutions selected and deployed in the various environments. These different IT solutions are disjointed and pose integration challenges Thus, referral processes and activities are sometimes considered better off through a manual system. However, one of the dangers is that the manual process is often prone to human errors. Therefore, the successful implementation of the NHI system depends on the flexibility of IT solutions, as they enable the integration and interoperability of heterogeneous IT solutions (Chitsa & Iyamu, 2020). Constant synchronisation of the health processes and patients' data will reduce data duplication at these different levels of healthcare service and allow for instant access to the patient's data and medical history in the NHI network.

Communication technologies such as internet connectivity are also essential to support the sharing and transportation of the data among healthcare stakeholders as they can be at different geographical locations. However, it is difficult to select and manage these complex healthcare IT solutions without enterprise architecture (EA) (Chitsa & Iyamu, 2020).

5.4.3 Geographical locations of stakeholders

Most NHI stakeholders are geographically dispersed, making it difficult to connect them for easier NHI resources sharing. Therefore, the implementation of the NHI system requires the formation of a network of NHI stakeholders based in different geographical locations to synchronise patients' data to meet the objectives easily. One of the objectives of the NHI system is to enable the citizens to access the needed quality healthcare service at their nearest healthcare provider, regardless of their affordability. As revealed in the analysis, a patient could visit a nearby primary accredited healthcare provider. From the primary healthcare (PHC) facility, private or public, the patient can be referred to a secondary or tertiary level for specialised care, depending on the patient's needs. Hence, flexible integration of IT solutions enables the synchronisation of the NHI processes and

patients' data. In addition, this effort is essential to the manageability of patients' data between private and public health facilities across the geographical locations of the country. The manageability, including the integration and flexibility of IT solutions, can be ensured and enforced through an EA.

The analysis revealed that successful implementation of the HIS can be hindered by critical factors, such as lack of good governance, lack of appropriate selection and deployment IT solutions, weak inclusiveness of stakeholders through their requirements (conditionalities), and lack of integrated IT solutions. This challenge is increasingly critical because, as evidenced in the analysis, there is an unequal distribution of IT solutions across the South African healthcare environment, making the NHI system implementation difficult. This inequality leads to challenges such as poor connectivity, hardware and software failures affecting the NHI registration and the referral processes during the first phase of the implementation of the NHI system at some rural areas pilot sites. These challenges can be addressed through EA, as the approach focuses on all spheres of NHI implementation, from information to IT solutions (Chitsa & Iyamu, 2020). In addition, readiness assessment is critical when implementing such new and complex IT solutions to mitigate the potential technical infrastructure challenges that may affect the NHI system's implementation process.

Synchronising patients' data and using flexible technology allow the collaboration of stakeholders from different geographical locations as they securely share and access the patients' confidential data and information on the network. This synchronisation, however, can be difficult in the absence of technical architectural guidance. Thus, the deployment of an EA can solve the problems of integration and interoperability of healthcare systems (Chitsa & Iyamu, 2020; Sajid & Ahsan, 2016).

5.4.4 Diversity of healthcare facilities

The implementation of the NHI system means the collaboration of both public and private healthcare facilities. These facilities are grouped based on the level and type of care offered. As noted in the analysis, the collaboration of the stakeholders in the NHI system can be based on the referral system. A referral system is a process whereby a patient can move from primary healthcare service to secondary or tertiary specialised care, depending on the healthcare needs. This process entails creating a heterogeneous network of different actors using IT solutions to offer the needed healthcare needs of the patients.

However, the current IT solutions are disjointed. As noted in the analysis, private and public healthcare institutions are disjointed because they are designed and implemented customarily to meet the specific healthcare institution's needs. The existence of these disjointed systems among the healthcare facilities hinders the integration, interoperability, and synchronisation of processes in the deployment of the NHI system. Thus, for the successful implementation of the NHI system, there is a need for flexible IT solutions to enable the secure sharing of the patients' data and information across the different healthcare facilities. Designing and developing such effective IT solutions require governance, including standardisation, principles and policies that promote the collaboration of the stakeholders, manageability of data, and synchronisation of processes with the guidance of an enterprise architecture. The EA consists of four interconnected domains, namely business, information, application, and technical. These domains should be deployed in alliance to "ensure holistic coverage, from business (health) goals and objectives, information exchanges and flows, to processing (eHealth) of activities and events" (Chitsa & Iyamu, 2020:727).

5.4.5 Flexibility of technology solutions

The flexibility of IT solutions is referred to as "the capacity of an IS to adapt, support, and enable organisational practices and change" (Bjorn et al., 2009:439). With the NHI stakeholders operating on different levels technologically, flexible IT solutions are crucial to facilitate the interaction of systems in the operationalisation of the NHI system to ensure effective performance. Flexible IT solutions reduce the risks of duplicating patients' data sets and the lack of interoperability of systems. Thus, the successful implementation of the NHI system is dependent on the flexibility of technology solutions. With new diseases and technology, IT solutions have to be flexible to incorporate possible adjustments in the NHI system.

In addition, the analysis has shown that, based on need, the NHI board will accredit more private healthcare services, such as Paediatrics, Gynaecology, and retail pharmacies, to ensure equitable access to medicines and specialised care. The enrolment of these stakeholders from different levels of health services means an addition to the diversity of the current NHI stakeholders and a need for synchronisation of the process to allow for the safe sharing and accessing of patients' data. This factor, among others, shows the need to develop flexible IT solutions capable of accommodating new requirements and enabling the integration and interoperability of solutions without impacting the existing solutions for the successful

implementation and deployment of the NHI system. However, the development of such flexible IT solutions can be a challenge without architectural guidance. An ETA "ensures that existing and new information technologies and systems are maintained and selected to achieve the organisation's strategic goals" (Iyamu, 2012:190).

5.4.6 Synchronisation of processes and patients' data.

Synchronisation is the coordination and integration of computing processes to enable the seamless sharing of resources among the stakeholders (Lomotey et al., 2017). As revealed in the analysis, the beneficiaries of the NHI system may seek healthcare services from any nearest accredited private or public healthcare provider. This situation entails registering the patients and medical information at any accredited PHC service provider, either public or private and should be accessed and updated from any geographical location countrywide by any NHI accredited service provider. Lack of synchronisation of patients' data and processes can cost the organisation time and resources.

Implementing the NHI system requires instant access and sharing of patients' data and medical history records in the NHI network. However, the lack of standardised processes and factors such as the health service levels, geographical location of stakeholders, and the type of healthcare facility can also hinder the integration and interoperability of the NHI system. Hence, the need for constant synchronisation of the health processes and patients' data. Synchronisation is also critical for the referral system, as it enforces interoperability of systems and allowing the interaction and collaboration of the stakeholders in the operationalisation of the NHI system. According to Chitsa and Iyamu (2020:727), the deployment of ETA "facilitates the integration, collaboration, standardisation, deduplication, and reengineering of IS/IT solutions" critical for the implementation of the NHI system.

5.5. Enterprise technical architecture framework for the implementation of the NHI

This section presents and discusses the enterprise technical architecture (ETA) framework that can guide the implementation of the NHI. The framework (Figure 5.3) was developed based on the interpretation of the findings as presented in section 5.4. Two main steps are involved in developing the ETA framework: step 1: the technical and non-technical factors that influence the ETA are mapped, as shown in Table 5.2. Step 2: the framework is developed. To better understand the framework and how it can be applied in implementing the NHI system, Table 5.2 and Figure 5.3 should be read with the following discussion.

5.5.1 Factors of the enterprise technical architecture framework

The ETA is influenced by 11 key factors that are process, activity and IT in nature. The factors are placed in columns and rows. As shown in Table 5.2, the factors on the “Y’ axis are vision, integration of health systems, consolidation of IT solutions, enterprise architecture, interoperability, data management, and governance. On the “X” axis, the factors are healthcare, legislature, patients’ need, and IT solutions. The X and Y axes align the influencing factors to understand how technical and non-technical, including human needs and governmental regulation, come together. Table 5.2 describes the alignment and relationships among the aspects of the NHI system and the factors that influence the ETA development.

TABLE 5. 2 FACTORS INFLUENCING THE DEVELOPMENT OF AN ETA

Factors	Healthcare	Legislature	Patients’ need	IT solutions
Vision	The ETA should incorporate both the NHI and healthcare vision. The vision includes the objectives and the future requirements of the NHI.	The vision of the NHI should align with the laws and acts that govern healthcare in the country.	The healthcare vision of the NHI should incorporate the patients’ needs across diverse backgrounds.	IT solutions should be shaped by the NHI vision. Connectivity across the country is the main requirement for the implementation of NHI.
Integration of health systems	Integrate healthcare services from both public and private facilities. Ensure a secure sharing of patients’ data across different healthcare facilities.	The integration of the healthcare systems to be guided by government policies.	Provide a platform that enables the secure sharing of patients’ needs across the various NHI stakeholders.	Ensure compatibility of the different IT health solutions. Eradicate redundant and duplicated IT solutions.
Consolidation of IT solutions	Ensure efficient healthcare operations from consolidated IT solutions. Avoid duplication of processes and wastage resources.	IT solutions should comply with the laws and the acts that govern the implementation of the NHI.	Provide access to information, improve communication and support the patient across the healthcare levels countrywide.	Allow for flexibility and compatibility of solutions. Enable the sharing of IT resources across the healthcare stakeholders.
Enterprise architecture	Link and align the different	Provide a framework on	Patients’ are critical. Enterprise	Ensure mapping of IT solutions and

Factors	Healthcare	Legislature	Patients' need	IT solutions
	healthcare processes and requirements across the healthcare stakeholders. Enable the alignment of the IT solutions and the business (healthcare) needs.	which the enterprise architecture is built. Policies and laws to support the development of an architecture.	architecture should be developed to meet the patients' needs.	the healthcare requirements in order to support the healthcare functions. The technical architecture domain of the enterprise architecture to manage the IT solutions.
Interoperability	Ensure access to healthcare data in a timely and secured manner. Optimise the healthcare systems during the operationalisation of the NHI system.	The NHI stakeholders to comply with the policies that govern the sharing and use of patients' data.	Improve patient's experience, efficiency, and reduce the error rate in the NHI system.	Different IT solutions to exchange the usable data among the NHI stakeholders.
Data management	Ensure proper data creation, storage, use, and sharing among the NHI stakeholders across the country.	Principles to govern the storage, use and sharing of patients' data among the NHI stakeholders.	Enable the effective use of patients' data across all the stakeholders of the NHI system in supporting patients' needs.	Ensure effective sharing of healthcare data among different IT solutions.
Governance	Ensure the setting and monitoring of the NHI objectives and strategic goals. Healthcare laws and policies to govern the healthcare environment, which is sensitive.	The NHI stakeholders should comply with the healthcare policies.	The patients should receive the expected healthcare from the NHI stakeholders. Policies to protect and secure the confidentiality of the patients' data and information.	Policies and principles to guide the selection, development and implementation of standardised IT solutions across the NHI healthcare facilities.

Based on the analysis conducted, the 6 key factors influencing the implementation of the NHI were (1) readiness assessment; (2), Government levels of health services; (3) Geographical locations of stakeholders; (4) Diversity of healthcare facilities; (5) Flexibility of technology solutions; and Synchronisation of processes and patients' data. These key factors as presented in Figure 5.2 were interpreted and led to the development of Table 5.2. Thus, the developed table (Table 5.2), presents the aspects of the NHI system and the critical factors influencing the development of the ETA. These critical factors (Table 5.2), were used to develop an ETA

framework, as shown in Figure 5.3, that can be used to guide the implementation of the South African NHI.

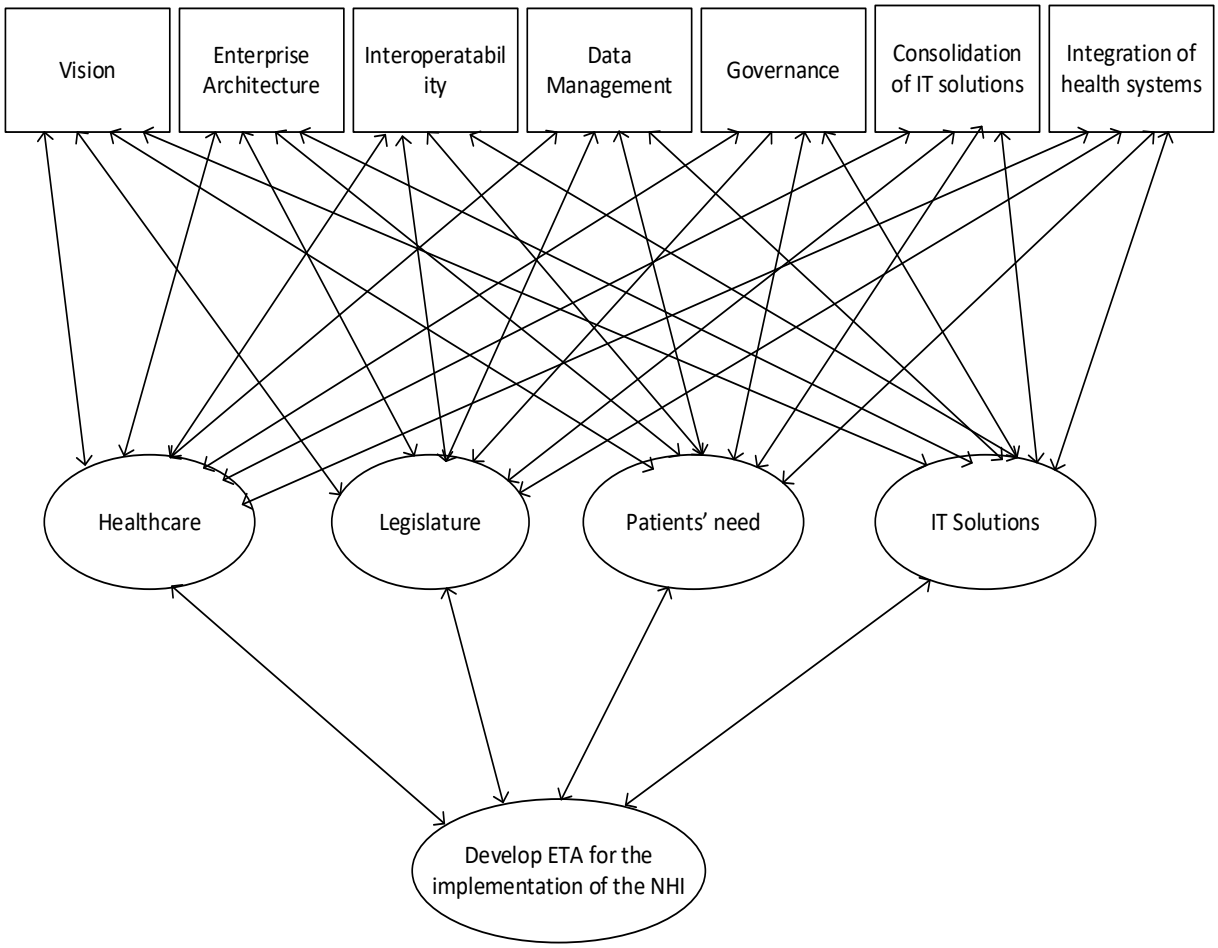

Figure 5. 3 ETA framework for the implementation of the NHI

The ETA framework presented the key influencing factors for the development of ETA to implement the NHI. These factors are vision, integration of health systems, consolidation of IT solutions, enterprise architecture, interoperability, data management, governance, healthcare, legislature, patients' needs, and IT solutions. Considering these factors may enable the development of an ETA that can guide the implementation of the NHI. The developers of the ETA should consider the need to select and deploy the IT solutions which align with the vision of the NHI and the healthcare systems. The vision includes the requirements and objectives of the healthcare and NHI. Acknowledging the vision of the NHI and the healthcare system's factors can lead to the selection of IT solutions that will enable connectivity across the healthcare facilities in the country.

Factors such as the consolidation of IT solutions and integration of health systems enable flexibility and compatibility, which are critical in the NHI system. Considering these factors can mitigate the existence of redundant, idle, and duplicate systems across the healthcare facilities as the best IT solutions for the implementation of the NHI can be selected and deployed. Enterprise architecture outlines the relationships between the strategic vision of an organisation and different levels of IT infrastructure (Ahsan et al.,2009). Thus, the need for the concatenation of EA and technical architecture to enable the alignment and connection of the IT solutions and the healthcare processes in the NHI system. The ETA can solve the problems of integration and interoperability of healthcare systems.

Governance refers to the set of standards, policies, and processes developed to ensure the accountability of activities in an organisation (Floridi, 2018). Due to the sensitive nature of the healthcare environment, there is a need for the ETA to comply with the policies from both the government and IT perspectives. Lastly, data management is another critical factor that ensures the effective capturing, storing, sharing, and use of patients' data across the NHI stakeholders.

5.6. Conclusion

This chapter presented an ETA framework, which is the aim of the study. This aim is achieved following three main steps. Firstly, by analysing the data that was collected. The analysis was conducted using the ANT's four moments of translation as a lens. Secondly, the findings from the analysis were interpreted, leading to the identification and mapping of the factors that influence the development of the ETA for the NHI. These technical and non-technical factors are shown in Table 5.2. Based on these factors, the ETA framework was developed (Figure 5.3) to guide the implementation of the NHI. The summary, conclusion, and recommendations of the study are presented in the next chapter.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1. Introduction

This chapter presents the conclusions and recommendations of the study to develop a technical architecture framework for implementing the South African national health insurance (NHI). The chapter is divided into eight main sections. Section 1 is an introduction, Section 2 summaries all the chapters, Section 3 provides an evaluation of the study, articulating how the research objectives were achieved, Section 4 outlines the contributions of the study, Section 5 gives some recommendations, Section 6 presents the limitations of the study, Section 7 gives suggestions for future work and finally, Section 8 concludes this dissertation.

6.2. Overview of the study

This study is divided into six chapters, and each chapter is summarised below:

Chapter 1

This chapter provided an overview of the study. Firstly, the introduction and the background of the study were outlined. The research problem was then articulated, which informed the research aim to develop an ETA framework for the implementation of the NHI. Three research objectives deduced from the aim and their corresponding research questions were presented in the chapter. Also outlined in Chapter 1 was a brief overview of the literature review and a summary of the research methodology.

Chapter 2

Chapter 2 presented the literature review of the study. The review was guided by the aim of the study to develop an enterprise technical architecture (ETA) framework that can guide the implementation of the South African National Health Insurance (NHI). Thus, a detailed review of the literature was conducted on the following areas of the study:

- Information Technology (IT)
- National Health Insurance (NHI)
- Implementation of NHI

- Enterprise architecture (EA)
- Enterprise technical architecture (ETA)

A review of the theory (Actor-Network Theory) that underpinned the study was also conducted and is articulated in the chapter. Lastly, a review of the ANT's use as a lens in IS studies was presented.

Chapter 3

The chapter presented a detailed research methodology employed in the study. The selection of the research methods was guided by the study's main aim, which was to develop an enterprise technical architecture framework. The methods discussed include philosophical assumptions, research approach, research method, research design, a case study, and the data collection and analysis techniques that were applied in the study. Justification of the methods employed was also presented in the chapter and the corresponding ethical considerations. Lastly, a list of 13 documents collected with the document analysis data collection technique was presented. The documents are shown in Table 3.1.

Chapter 4

Chapter 4 presented the overview of the case study, which is the South African NHI. The chapter articulated the structure of the NHI case. Also, the chapter explained the NHI key stakeholders, their roles and their responsibilities in the implementation of the NHI. These stakeholders include; government institutions, the public health sector, private health sector, and citizens. A detailed data collection process was also presented in the chapter. Lastly, the chapter provided brief information on the ongoing piloting of the NHI programme in the country.

Chapter 5

Chapter 5 presented the data analysis process conducted using the four moments of translation from the perspective of ANT. Through the theory, actors and networks involved in the implementation of the NHI were identified. Also outlined in the chapter are the findings from the analysis (Figure 5.2) and the interpretation of findings. The enterprise technical architecture framework (Figure 5.3) was developed based on the interpretation of findings. The framework; the aim of the study, can be used to guide the implementation of the NHI system in the country.

6.3. Evaluation of the study

This section presents the evaluation of the study. The purpose of evaluating a study is to ascertain the accomplishment of the study's aim and objectives. As stated in Chapter 1, the study aimed to develop an enterprise architecture framework for implementing the NHI. Based on that aim, the objectives were drawn. These objectives were;

- To examine the factors that can influence the implementation of the South African NHI.
- To examine the technology infrastructures, information exchange, and business (healthcare) requirements for the implementation of the South African NHI.

The main research question, which was based on the aim of the study as presented in the first chapter, was; how can an enterprise technical architecture framework be developed to guide the implementation of the South African NHI system? Subsequently, the two corresponding research sub-questions were derived, which were;

- What are the factors that can influence the implementation of the South African NHI?
- What are the technology infrastructures, information exchange, and business (healthcare) requirements for the implementation of the South African NHI?

To achieve the study's aim as stated above, the collected qualitative data was first analysed using the ANT's four moments of translation, as presented in Chapter 5. The findings from the analysis were interpreted, which led to achieving the research objectives and answering the research sub-questions. Lastly, the analysis of the findings from the objectives guided the development of the ETA framework for the NHI. The process for obtaining the objectives of this study and attaining the research questions were answered is discussed as follows:

Research objective 1

The first research objective was to examine the factors that can influence the implementation of the South African NHI. The corresponding research sub-question was, what factors (such as process, governance, and legislature) can influence the implementation of the South African NHI?

The analysis revealed that the NHI is a system that involves a variety of stakeholders. The factors which influenced its deployment and implementation were articulated in Section 5.4 of Chapter 5. The study found that the deployment and implementation of the NHI system were influenced by readiness assessment, government levels of health services, geographical locations of stakeholders, diversity of healthcare facilities, the flexibility of technology solutions, and the

synchronisation of processes and patients' data. These factors, as explained in Chapter 5, are not independent of each other and are summarised as follows;

The implementation of NHI involves various stakeholders from both the public and private healthcare institutions operating at different levels of health services and can be at different geographical locations. Thus, communication is critical primarily to support the sharing and transportation of the data among the healthcare stakeholders. However, these different healthcare stakeholders use different customised IT solutions as they operationalise the healthcare service. According to the analysis conducted, there seems to be no readiness assessment conducted before the piloting of the NHI in the context of technology. Hence, the existence and utilisation of disjointed IT solutions at different public and private healthcare institutions pose integration and compatibility challenges. As revealed in the analysis, the successful implementation of the NHI can be hindered by critical factors such as lack of good governance, lack of appropriate selection and deployment of IT solutions, lack of standardised processes, and lack of integrated IT solutions.

Research objective 2

The second research objective was to examine the technology infrastructures, information exchange, and business (healthcare) requirements for the implementation of the South African NHI. The corresponding sub-research question for this objective was; what are the technology infrastructures, information exchange, and business (healthcare) requirements for the implementation of the South African NHI?

From the analysis, it was revealed that NHI is an IT-enabled system. The beneficiaries of the NHI system may seek healthcare services from any nearest accredited private or public healthcare provider to increase the UHC. To achieve such NHI objectives, there is a need to instantly access and share the patients' data and medical history records in the NHI network. According to the analysis conducted, it was noted that these accredited healthcare providers were operating at different levels of technology usage; some were transitioning from paper-based to electronic, while others maintained both paper-based and electronic records. In addition, there is an unequal distribution of IT solutions across the South African healthcare environment. Such factors hindered the seamless sharing of patients' data and resources among the NHI stakeholders. The flexibility of technology solutions was found critical for the successful implementation of the NHI as it enables the integration and interoperability of heterogeneous IT solutions. In addition,

constant synchronisation of processes and patients' data is also a factor that can reduce the duplication of data at the different healthcare services in the NHI network.

The aim of the study

The study aimed to develop an enterprise architecture framework for the implementation of the NHI. The main research question was, how can an enterprise technical architecture framework be developed to guide the implementation of the South African NHI system?

Based on the interpretation of findings, the enterprise technical architecture (ETA) framework (Figure 5.3) which can be used to guide the implementation of the NHI framework, was developed. The development of the framework as presented in Section 5.3 was influenced by the 11 factors: vision, integration of health systems, consolidation of IT solutions, enterprise architecture, interoperability, data management, and governance, healthcare, legislature, patients' need and IT solutions. These factors were presented and explained in Section 5.5. Table 5.2 mapped and aligned these factors, primarily to point out how both technical and non-technical aspects of the NHI, including the human needs and governmental regulations come together in influencing the development of the ETA. The framework (Figure 5.3) presents the critical factors IT specialists can consider when developing the ETA for the NHI. Thus, the ETA can be developed for the successful implementation of the South African NHI with the framework as a guide.

6.4. Contributions of the study

The contributions of the study are from both theoretical and practical viewpoints. The contributions are presented in this section.

Theoretical contribution

Theoretically, the study contributed to the existing literature. The enterprise technical architecture framework and literature contribute to the body of knowledge from South African healthcare and IS research perspectives. The technical and non-technical factors that influenced the implementation of the NHI system were given through the study. In addition, the factors which influence the development of the ETA for the implementation of the South African NHI were also presented. Understanding these influencing factors can also be of theoretical contribution to other developing countries intending to implement similar health systems. Another theoretical contribution is the use of ANT in the study. The ANT's four moments were applied in the study in

unpacking the enrolment, roles, and relationships of actors in the NHI network during the implementation of the NHI.

Practical contribution

From the practical viewpoint, the enterprise technical architecture framework was developed based on the findings from the analysis of the study. The study developed an ETA framework for the implementation of the NHI in South Africa. The framework can be used to guide the implementation of the NHI. As revealed in the analysis, the current implementation of the NHI is not guided by architecture, and the process has been challenging technology-wise. Thus, through the framework, the ETA can be developed to address the current and possible future technological challenges such as non-compatibility, flexibility, and integration of solutions in the implementation of the NHI. An enterprise technical architecture is required to address the fundamental challenges and to enable and support NHI implementation.

6.5. Recommendations of the study

Based on the analysis and findings presented in Chapter 5, two gaps were identified. These gaps and recommendations are provided in this section as follows;

6.5.1. Equitable distribution of healthcare IT resources

For the South African government to implement the ETA, there is a need to increase the distribution of IT resources in the public healthcare environment. As revealed in the study, there is an unequal distribution of IT resources in the Public South African healthcare institutions due to geographical factors. The unequal distribution of IT infrastructure and poor adoption of eHealth is impacting the implementation of the NHI. Hence, the recommendation is that the government invest more in the healthcare institutions towards transitioning from the manual to electronic processes for the successful deployment of the ETA.

6.5.2. Development of other EA domains

The study developed the framework for the development of ETA. However, based on the analysis, it is also recommended that other domains of enterprise architecture (EA) be considered for the successful implementation of the South African NHI. EA comprises a variety of domains, and

each domain produces different deliverables and has its boundaries. Deploying other EA domains, such as information architecture (IA) and application architecture (AA) during the implementation of the NHI, can help to confine the healthcare's information and manage the designing and deployment of applications needed to achieve the objective of the NHI system.

6.6. Limitations of the study

The aim of the study was limited to the implementation of the South African NHI from the enterprise technical architecture perspective. The study did not cover areas such as the readiness assessment and other domains of enterprise architecture that can be critical for implementing NHI in the country.

6.7. Further research

The study developed a framework for the development of the ETA, which can guide the implementation of the South African NHI. Based on the analysis and findings of the study and the newness of the programme, further studies relating to the implementation of the NHI are recommended. Further studies should apply other data collection techniques, such as interviews, in addition to the document analysis that was applied in this study. Also, the data should be analysed using different lenses. Other socio-technical theories like structuration and activity theory can also be used as lenses and complementary use of two theories. These can bring different perspectives to the implementation of the South African NHI from the IT perspective, which is critical and fairly new.

6.8. Conclusion

Chapter 6 presented the conclusions and recommendations of the study. The study examined the factors which influence the implementation of the NHI. Using the ANT's four moments of translation, the qualitative data collected using the document analysis was analysed. Findings from the analysis were interpreted, and an enterprise technical architecture (ETA) framework was developed that can be used to guide the implementation of the South African NHI. The chapter provided a summary of the entire study. This chapter also highlights the evaluation of the study, its contribution from the theoretical and practical perspectives, recommendations, limitations of the study, and areas for further research.

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