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An enterprise technical architecture for the implementation of the South African National Health Insurance

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Abstract

The South African National Health Insurance (NHI) faces challenges due to a lack of an enterprise technical architecture (ETA) solution, for the implementation. This study aims to propose an ETA, to enable and support the implementation of the South African ETA. The qualitative method was employed in the data collection. Actor-network theory (ANT) was applied as a lens to examine the data. The findings reveal several critical influencing factors, including readiness assessment, geographical locations of stakeholders; diversity of healthcare facilities; flexibility of technology solutions; and synchronization of processes and patients' data. The study highlights the need to provide governance for the technologies that influence the implementation of NHI. Based on the influencing factors, a framework was developed. The framework is intended to provide architectural governance (principles, standards, and policies), to efficiently and effectively, facilitate, support, and enable the implementation of the South African NHI.

KEYWORDS

actor-network theory, Enterprise architecture, Enterprise technical architecture, health insurance

1 | INTRODUCTION

In terms of practice, 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. The NHI ensures extended coverage and increases access to health services regardless of socioeconomic status (Cape, 2015). The current health system is two-tiered and it promotes socioeconomic status. It is thus intended to address challenges within the South African health sector, which have become severe, primarily because it lacks equitable access to healthcare (Marten et al., 2014). On one hand, public healthcare centres are often under-resourced, and infrastructures are obsolete compared to private healthcare providers (Mhlaba et al., 2016). NHI, on the other hand, is expected to provide healthcare services through both certified private and public healthcare providers (Marten et al., 2014).

Despite the importance of the NHI in the country, the implementation remains challenging. An area of the challenge is how to employ IT solutions, to enable and support patients' datasets including the processes and activities of the NHI system. The challenges were propelled due to the lack of a technical architecture, to govern factors such as technology infrastructure disintegration, information manipulation, and processes (Chitsa & Iyamu, 2020). Thus, an enterprise technical architecture (ETA), a domain of the enterprise architecture (EA) is required to address the fundamental challenges in enabling and supporting NHI implementation. EA is an approach that provides a holistic view including bridging the gap between the technology infrastructure and non-technology units of an enterprise (Dale & Scheepers, 2020; Kotusev, 2019). Iyamu (2022) affirms that the obstinate nature of events and challenges motivates organizations to seek a redeemable approach such as EA.

The ETA ensures that the existing and modern IT solutions are selected and maintained respectively to achieve the strategic goals of an organization (Constantinides et al., 2018; De Vries & van Rensburg, 2008). Iyamu (2023) explains how ETA is a prevailing paradigm, which questions

the goals, scope, processes, and roles considered on the technology front. However, the development and use of ETA, to enable and support NHI involve several phases and consist of various stakeholders. The stakeholders made decisions at different stages or phases, for or against the deployment of IT solutions. Decisions are often negotiated. The decisions are based on how the issues concerning ETA are problematized including the interest of individuals or groups (stakeholders). During the NHI implementation pilot, it was not empirically known, why and what influenced individuals' decisions and interests.

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 IT solutions such as poor connectivity, and hardware problems hindered the participation of some clinics (Child, 2019). It was also reported that poorly designed systems affect the implementation of IT systems for healthcare service delivery (Jeffries et al., 2017). Many IT solutions' challenges manifest from a lack of governance (Johnston & Gillam, 2019). ETA is a domain of EA that focuses on technology governance including selection, use, and management. According to Iyamu (2012), ETA bridges the gap between the enabler and the enabled, pragmatic assessment and technology solutions in addressing the needs, and semiotics of IT solutions' deployment. ETA stabilizes the deployment and use of IT solutions in an environment. Without architectural guidance, IT solutions encounter challenges and fail to enable and support goals and objectives towards fulfillment.

This study was undertaken based on the challenges identified above. The study aims to propose an ETA that can be used to enable the implementation of the NHI, in South Africa. In achieving the aim, two research questions were formulated: (1) what are the factors that influence the ETA development for NHI? (2) How can an ETA be used to enable the implementation of the NHI? In answering the research questions towards achieving the aim, it was essential to examine the interactions among the stakeholders and the translation of activities including how negotiation shifted during the processes. This was to gain a deeper understanding of how things could have manifested into the various decisions. This led to the selection of actor-network theory (ANT) to underpin the study. The theory is the only theory that focuses on both translation (Callon, 1986) and shifting negotiation within networks (Latour, 2005).

2 | LITERATURE REVIEW

2.1 | National Health Insurance

The NHI refers to a publicly funded scheme that is managed by the country's government to ensure the healthcare cost of its citizens achieves universal health coverage (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 the affordability by 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 realization that the current health system is biased and undermines the rights of unemployed citizens and 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 healthcare 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), which makes the implementation critical.

From health systems perspective, Sligo et al. (2017, p. 86) argued that implementation is "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 operationalization and fulfillment (Chitsa & Iyamu, 2020; Ross et al., 2016). Patient 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 becomes a challenge without architecture. It is within this context that Passchier (2017) emphasized on the investment in IT infrastructure for the successful implementation of NHI in South Africa.

The implementation process, as stated by Sligo et al. (2017), requires an organizational 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). Architectural design is often used as 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 behavior 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 reveal that IT problems attributable to poorly designed systems at some clinics are affecting the implementation of the programme (Child, 2019).

2.2 | Enterprise technical architecture

EA comprises four main domains enterprise business architecture (EBA), enterprise application architecture (EAA), ETA, and enterprise information architecture (EIA) (Chitsa & Iyamu, 2020; Sajid & Ahsan, 2016). Like the other domains, ETA is a model that uses unique technologies to attain its deliverables (Castellanos & Correal, 2012). An ETA, as explained by Iyamu (2012, p. 190), “ensures that existing and new information technologies and systems are maintained and selected to achieve the strategic goals of the organization”. 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 middleware, data, security, distributed, platform, and network domains (Iyamu, 2012).

From an IT solutions perspective, the ETA domains enable and support healthcare systems such as the NHI through the integration of systems and data. Sajid and Ahsan (2016) explain how IT solutions enhance the interoperability and integration of data across the stakeholders' environments. Thus, Ahsan et al. (2009) argued that the absence of architectural guidance leads to the failure of many IT projects in the healthcare sector due to a lack of interoperability and integration. Hence, the selection and use of IT solutions are critical, and the process involves negotiations among the stakeholders. Also, based on individuals' translations, there are various interests, which lead to the formation of networks, consciously or unconsciously. Thus, actors' involvement in the activities and processes of IT solutions inevitably brings about negotiation, to reach a common goal in the interest of the environment (Iyamu, 2021: P. 76).

Additionally, the alignment and standardization of processes and activities relating to healthcare systems remain challenging. Price et al. (2018) suggested that alignment between healthcare objectives and IT solutions can be addressed using ETA. In such as situation, translation occurs, that is, when the human actors' interests are aligned with their actor-network (Walsham, 1997). Widén and Haseltine (2015) emphasized the criticality of IT solutions' standards in deploying health information systems. A lack of standardization and governance leads to the selection of inappropriate IT solutions (Johnston & Gillam, 2019).

The pilot of the implementation of SA's NHI, according to a recent study by Chitsa and Iyamu (2020), was not guided by ETA. 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 (Child, 2019; Chitsa & Iyamu, 2020). Chitsa and Iyamu (2020) further explain how SA's healthcare documents and policies do not consider 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, and consistent loss of data and information due to poor data security measures (Aubakirov & Nikulchev, 2016).

2.3 | Actor-network theory

ANT is selected to underpin the study for two reasons, translation, and shifting negotiation. Primarily, ANT focuses on translation and shifting negotiation among involved actors, within actor-network (Callon, 1986; Law, 1992). Latour (2005) explains how a network incorporates human and non-human actors and stabilizes translations and interactions between actors. In the context of healthcare, Muhammad and Wickramasinghe (2016) argued that ANT can be applied to get a better comprehension of healthcare operations and processes through the interactions of the healthcare stakeholders with the technology. The theory was useful in examining the relationships and interactions that happened among the stakeholders, to determine how negotiation shifted in the processes (Shaanika & Iyamu, 2015).

2.3.1 | Translation

Translation, a key tenet of ANT, facilitates the alignment and mediation of diverse actors' interests and actions within a network (Iyamu, 2018). Its role in negotiating meanings and creating shared understandings makes it particularly suitable for identifying the factors of influence towards development of ETA for NHI implementation. Translation occurs in stages, referred to as moments of translation. The moments of translation consist of four key stages, problematization, intersement, enrolment, and mobilization (Callon, 1986). Through the moments of translation, the study exhumes how actors engaged in the process of aligning their interests, negotiating processes, and meanings on why and how to employ ETA in the implementation of NHI.

Problematization is the first moment of translation is problematization, 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). The next moment, intersement, explains how actors are recruited to be part of a network meant to solve the problem problematized. During this stage, the main actor attracts the attention of other actors by proposing different roles and responsibilities to lock different actors into a network (Heeks & Stanforth, 2015). This is followed by enrolment, in which actors partake in solving the problems assigned to them (Waeraas & Nielsen, 2016). Enrolment thus involves the actual participation or action of actors in a network. During the implementation of healthcare systems, the participation of non-technical actors, such as policies and processes, can thus be considered obligatory, as their presence is mandatory. Mobilization, the last stage of translation entails the communication and sharing of information about tasks carried out by the spokesperson or the representative of that network (Shim & Shin, 2016). According to Makovhololo and Iyamu (2020, p. 7), “the focal actor needs to continually convince the actors that their interests are still the same”. Thus, the mobilization process is intended to strengthen the formed network (Iyamu, 2013).

Shifting negotiation—One of the main focuses of ANT is understanding how negotiations shift among actors, consciously or unconsciously (Callon, 1986). In the implementation of NHI, decisions about the enabling technologies were made at different levels and by various groups of stakeholders. Those decisions were reached as negotiations shifted. Iyamu (2021) argues that everything in the social and natural world exists in constantly shifting negotiations in networks of relationships (P. 74), thus, actors' involvement in the activities and processes of IT solutions inevitably brings about negotiation, to reach a common goal in the interest of an environment (P. 76). Consciously or unconsciously, negotiations happen and often shift as the event progresses. What remained unknown is how and why the negotiations shifted, to manifested into the selection of technologies. This helps to understand the factors that influence the activities and processes in using ETA to support and enable NHI.

3 | RESEARCH METHODOLOGY

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). Håkansson (2013, p. 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.” The qualitative method allows a deeper understanding and seeks to capture thoughts and subjective viewpoints (Creswell & Poth, 2017). This enabled us to extract views from existing documents, as presented in Table 1. Sutton and Austin (2015) argued that the qualitative method allows researchers to capture richer

TABLE 1 Data collected.

Type of document	Code	Description	Number of pages
Government Gazette	GG-01	The proposed NHI policy notice. The notice was gazetted on the 11th of December 2015	98
	GG-02	White paper on the NHI. 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 NHI 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 country's NHI. The report answers the “What, Who, Why and How” of the NHI programme	97
Newspaper article	NA-01	An article on the assessment of the pilot project for the period of 2012–2017	5
Total pages			1185

Abbreviation: NHI, National Health Insurance.

data from the participants. The method was helpful because it provided deeper insights into real-world problems (Martelli & Greener, 2018). Hence, characterized as a descriptive method of the phenomenon being studied (Saunders et al., 2019).

3.1 | Case study design

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 NHI. As a new phenomenon, which at the time of this study had yet to be 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. 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 (Iyamu, 2018).

3.1.1 | Government institutions

In the context of the NHI stakeholders, the South African government, as presented in Figure 1, is divided into two sub-sections: The Parliament and the Department of Health. The role of the national Parliament as a stakeholder in NHI is to finalize the NHI bill. The National Department of Health is responsible for the development, setting of standards, and coordinating national health policies.

3.1.2 | Citizens

South African citizens are required to play a vital role in the NHI implementation because the country has been built on the socio-economic status of inequity. Inequality shapes the divide between the private and the public healthcare sectors. Thus, it was important for the citizens to participate in this study.

3.1.3 | Public health sector

The public health sector is divided into three main layers: primary, secondary, and tertiary health care services. Primary health care services focus on providing basic health needs, services often offered at district health centres. Secondary healthcare provides specialist support to primary care centres, which are delivered through regional hospitals. The third level is tertiary, which consists of provincial hospitals and specialized hospitals, which only work with referral systems.

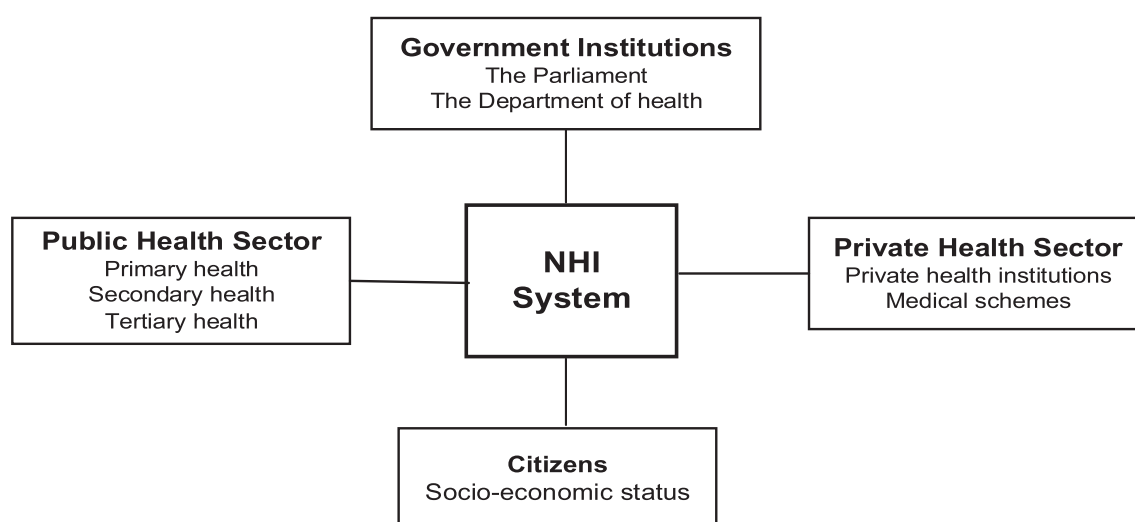


FIGURE 1 NHI's main stakeholders. NHI, National Health Insurance.

3.1.4 | Private health sector

Private healthcare is divided into two, private health institutions and medical schemes. Private health institutions comprise surgeries, private hospitals, and pharmacies run by individuals or groups. Medical schemes pool their members' contributions and provide funding for private healthcare services.

3.2 | Data collection

Thus, we gathered materials that focused on government institutions in the context of healthcare, the public health sector, the private health sector, and the citizens of the country. To gather a wide range of materials about the phenomenon being studied, the Boolean operators: AND, OR, and NOT were used in the search query. Keywords, healthcare, universal health, health insurance, and NHI were used in the search for materials. The search was conducted on the South African government databases including healthcare-related databases in the country. The focus was on the country primarily because of the uniqueness of the phenomenon.

As shown in Table 1, a total of thirteen (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 accordingly. For example, code GG-01; GG refers to the type of document, which is a government gazette, and the 01 represents the first gazette, which is the proposed NHI 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 1.

3.3 | Data analysis

For ease of referencing during the data analysis process, the 13 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 a 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.

To achieve the stated objectives, the analysis process was conducted from the interpretive 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.

The data were analyzed using the interpretive approach perspective (Goldkuhl, 2012; Walsham, 2014). The analysis was guided using ANT as a lens. The inductive approach (Azungah, 2018) was employed in identifying the factors that could influence the ETA for NHI implementation. Based on which six factors were identified as the key influencing factors: (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 (6) Synchronization of processes and patients' data.

4 | FINDINGS AND DISCUSSION

4.1 | 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). There are four main moments in translation: problematization, intersement, enrolment, and mobilization networks (Callon, 1984; Iyamu, 2013). 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 analyzed, using the four moments of translation as a lens.

4.1.1 | Problematization

Problematization is the first moment of the translation process. This moment is when 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 problematized the need to attain 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 problematized. The latter is based on the former. Also, the focus of this study is on how to employ the ETA to govern the use of IT solutions, to enable the implementation of the South African NHI.

The implementation of the South African NHI system was key for achieving UHC. The NHI fund intended to bridge the gap in the healthcare system by pooling the funds to provide the needed healthcare 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 problematization of the NHI by the government followed several steps. First, the initial development and implementation of the NHI system were supported by policies and laws. Second, it was the NHI green paper, published in 2012 for contributions and comments from the public. Third, 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 passed into law by the legislative arm of the government.

This process of problematization 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 healthcare practitioners. This happened through the piloting of the NHI system. The 11 piloting district sites (with at least a site per province) were selected demographically, and the socio-economic status, and 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 pilot programme increases stakeholders' levels of understanding and awareness of the NHI implementation plans and vision as they participate. 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 the IT solutions' perspective, the NHI was problematised by IT personnel in the government. This action was done for 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, problematization was intended to explain the NHI in enabling and supporting 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 problematization 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 problematization. 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.

4.1.2 | 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 is 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:

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 to create a comprehensive national health information system (SD-03, pg.15).

Thus, as the enablers of the NHI system, 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. Professionalism and national interest drive such 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 goals 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 actualization 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 implementations of the NHI system at the time of the study, regardless of their interests.

4.1.3 | 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 problematized 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 due to various circumstances unexplained. 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 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 of 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 patient registration process at the time of the study. The system was used to capture the patients' details as they registered to become 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 leading 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 patient's data and information among the NHI stakeholders.

4.1.4 | Mobilization

Mobilization 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, mobilization 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 mobilized the strategic operationalization of the NHI system in several ways. First, they accredited and enforced the participation of 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. Mobilization 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 mobilizing the healthcare activities at the designated centres, ensuring the customized implementation of the NHI system using the available IT solutions. This was done by mobilizing 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 mobilization was done by providing the IT solutions and resources required to implement the system. The IT managers mobilized 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 HISs being used by healthcare institutions at the time of the study to customize the implementation of the NHI system across the country.

5 | THE INFLUENCING FACTORS

Based on the analysis of the data presented in the previous section, six 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 (6) Synchronization of processes and patients' data. As shown in Figure 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.

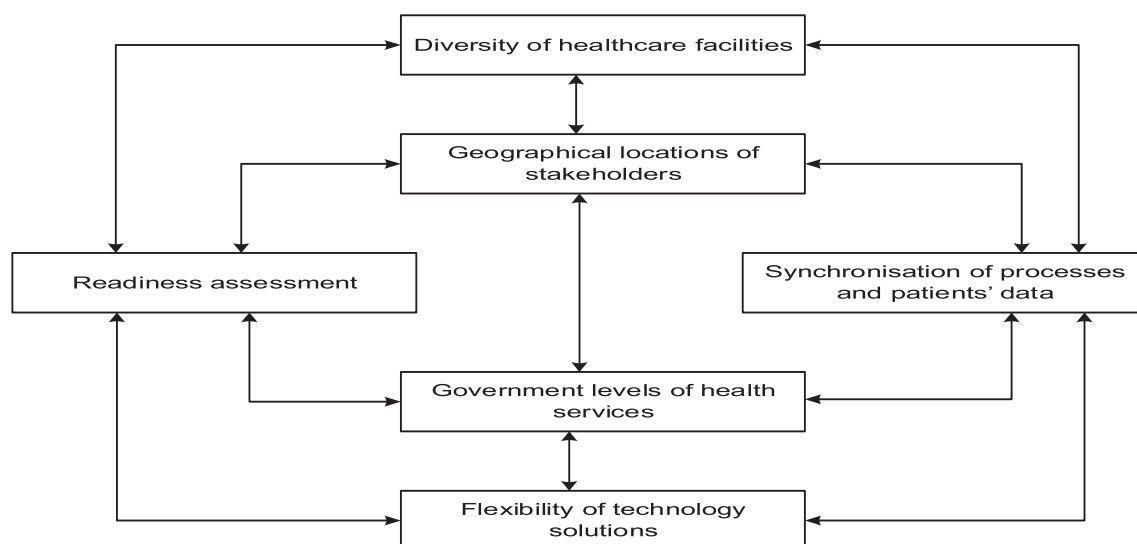


FIGURE 2 Factors influencing NHI implementation. NHI, National Health Insurance.

5.1 | Readiness assessment

Readiness assessment is the systematic analysis conducted by an organization before adopting or implementing a technology solution. The process increases the organization'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 synchronizing patients' data and consolidating technologies impossible. The health department manages the procurement process of the IT infrastructure for public healthcare institutions, using standards and principles different from the private institutions. However, the implementation thereof is decentralized at primary and secondary levels while governed by a set of policies. Hence, the existence and utilization of disjointed IT solutions at different public and private healthcare institutions are non-compatible.

The analysis showed that healthcare institutions from both private and 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 ETA in the development of the IT solution.

5.2 | 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 GPs 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 specialized care, such as urology and cardiology. The third level is tertiary, which offers more advanced and specialized 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 customized IT solutions to operationalize 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 synchronization 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 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 EA (Chitsa & Iyamu, 2020).

5.3 | Geographical locations of stakeholders

Most NHI stakeholders are geographically dispersed, making it difficult to connect them for easier NHI resource sharing. Therefore, the implementation of the NHI system requires the formation of a network of NHI stakeholders based in different geographical locations to synchronize patients' data to meet the objectives easily. One of the objectives of the NHI system is to enable 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 specialized care, depending on the patient's needs. Hence, flexible integration of IT solutions enables the synchronization 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 of 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, and hardware and software failures affecting the NHI registration and 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.

Synchronizing 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 synchronization, 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 | 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 PHC service to secondary or tertiary specialized care, depending on the healthcare needs. This process entails creating a heterogeneous network of different actors using IT solutions to meet the 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 healthcare facilities hinders the integration, interoperability, and synchronization 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 patient data and information across the different healthcare facilities. Designing and developing such effective IT solutions require governance, including standardization, principles, and policies that promote the collaboration of the stakeholders, manageability of data, and synchronization of processes with the guidance of EA. 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).

5.5 | Flexibility of technology solutions

The flexibility of IT solutions is referred to as “the capacity of an IS to adapt, support, and enable organizational 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 operationalization 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 must be flexible to incorporate 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 Pediatrics, Gynecology, and retail pharmacies, to ensure equitable access to medicines and specialized 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 synchronization of the process to allow for the safe sharing and accessing of patient 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 organization's strategic goals” (Iyamu, 2012:190).

5.6 | Synchronization of processes and patients' data

Synchronization 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 synchronization of patients' data and processes can cost the organization 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 standardized processes and factors such as the health service levels, the geographical location of stakeholders, and the type of healthcare facility can also hinder the integration and interoperability of the NHI system. Hence, there is a need for constant synchronization of the health processes and patients' data. Synchronization is also critical for the referral system, as it enforces the interoperability of systems and allows the interaction and collaboration of the stakeholders in the operationalization of the NHI system. According to Chitsa and Iyamu (2020, p. 727), the deployment of ETA “facilitates the integration, collaboration, standardization, deduplication, and reengineering of IS/IT solutions” critical for the implementation of the NHI system.

6 | ETA FRAMEWORK FOR THE IMPLEMENTATION OF THE NHI

This section presents and discusses the ETA framework that can guide the implementation of the NHI. The framework (Figure 3) was developed based on the interpretation of the findings as presented in Section 5. 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 2. Step 2: the framework is developed. To better understand the framework and how it can be applied in implementing the NHI system, Table 2 and Figure 3 should be read with the following discussion.

6.1 | Factors of the enterprise technical architecture framework

The ETA is influenced by eleven (11) key factors, which are process, activity, and IT in nature. The factors are placed in columns and rows. As shown in Table 2, the factors on the “Y” axis are vision, integration of health systems, consolidation of IT solutions, EA, interoperability, data management, and governance. On the “X” axis, the factors are healthcare, legislature, patients' needs, 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. The ETA framework can be used in addressing the challenges of implementing the South African NHI, as follows:

1. Have a good understanding of Table 2, which describes the alignment and relationships among the aspects of the NHI system and the factors that influence ETA development.
2. The content of each cell (conjunction of the X and Y axes) in Table 2 is a deliverable. Each deliverable should be enforced through policy.

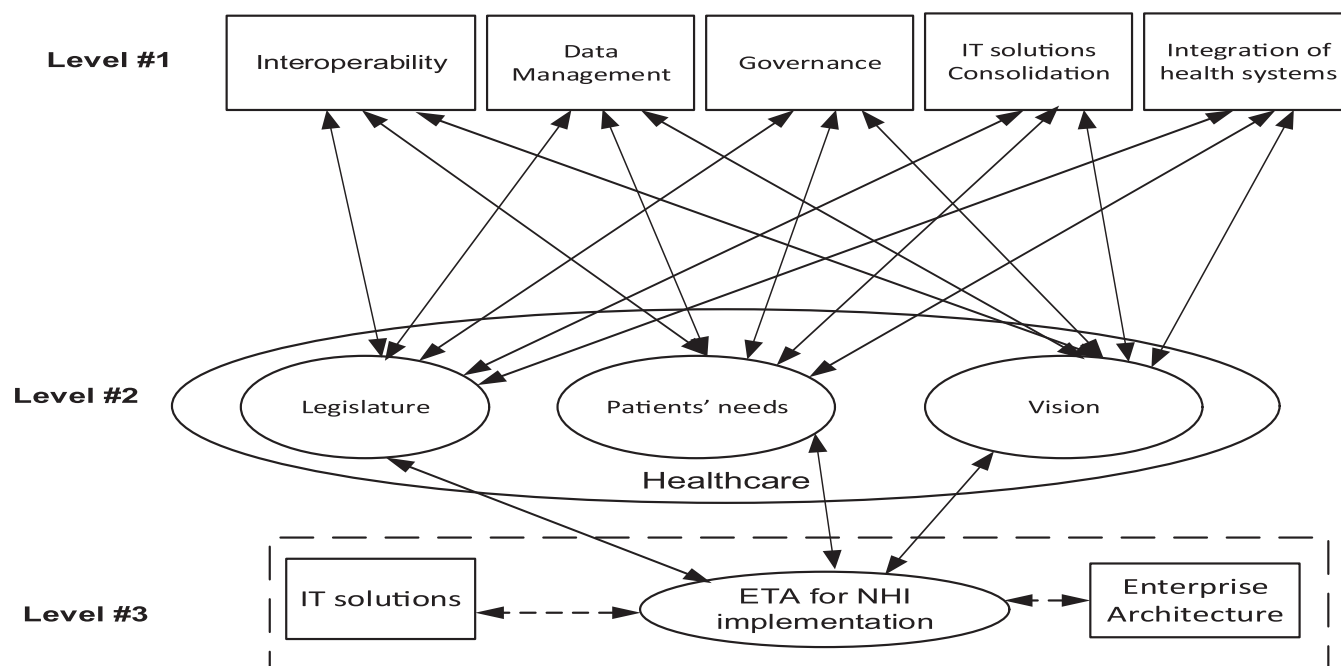


FIGURE 3 ETA framework for the implementation of the NHI. ETA, enterprise technical architecture; NHI, National Health Insurance.

Table 2 presents the aspects of the NHI system and the key factors influencing the development of the ETA. Based on these critical factors (Table 2), an ETA framework was developed, as shown in Figure 3, to guide the implementation of the South African NHI. In doing so, the 11 factors were divided into three groups, which makes the levels. The levels are technical, non-technical, and architectural entities.

1. **Level #1:** This is the technical entity. It consists of existing IT-related elements. This includes interoperability, data management, governance, IT consolidation, and integration of health systems. Each of these factors must be understood and documented, to enable assessment of their capability and deficiency in developing the ETA.
2. **Level #2:** This level contains the non-technical factors. Umbrellaed by healthcare, it comprises of government's legislature, patients' needs, and vision of the NHI. The level determines the trajectory of the NHI in the country.
3. **Level #3:** This is the architectural entities, the ETA, EA, and IT solutions. On the one hand, the development of ETA is guided using EA principles. This is primarily because ETA is a domain of the EA, as explained in section 2.2. On another hand, IT solutions are involved and enable ETA development.

The ETA framework presents 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, EA, 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 healthcare facilities as the best IT solutions for the implementation of the NHI can be selected and deployed. EA outlines the relationships between the strategic vision of an organization and different levels of IT infrastructure (Ahsan et al., 2009). Thus, there is a need for the concatenation of EA and ETA 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 organization (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.

TABLE 2 Factors influencing the development of an ETA.

Factors	Healthcare	Legislature	Patients' needs	IT solutions
Vision	The ETA should incorporate both the NHI and healthcare vision. The vision includes the objectives and 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 is guided by government policies	Provide a platform that enables the secure sharing of patient's 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 waste 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 healthcare stakeholders
Enterprise architecture	Link and align the different healthcare processes and requirements across the healthcare stakeholders. Enable the alignment of IT solutions and healthcare needs.	Provide a framework on which the EA is built Policies and laws to support the development of an EA	Patients are critical. EA should be developed to meet the patient's needs	Ensure mapping of IT solutions and the healthcare requirements, to support the healthcare functions The ETA domain of EA to manage the IT solutions
Interoperability	Ensure access to healthcare data in a timely and secure manner. Optimize the healthcare systems during the operationalization of the NHI system	The NHI stakeholders to comply with the policies that govern the sharing and use of patients' data	Improve patient experience, and efficiency, to reduce the error rate in the NHI system	Different IT solutions to exchange usable data among the NHI stakeholders
Data management	Ensure proper data creation, storage, use, and sharing among 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 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 patient's data and information	Policies and principles to guide the selection, development, and implementation of standardized IT solutions across the NHI healthcare facilities

Abbreviations: EA, enterprise architecture; ETA, enterprise technical architecture; NHI, National Health Insurance.

7 | CONCLUSION

The study developed an ETA framework to implement the NHI in South Africa. This ETA framework can be of significance to the South African government as it can be used as a guide to fully implement the NHI in the country. Healthcare practitioners and IT people in the health sector can also benefit from the study. The ETA framework can be used as a guideline when developing IT solutions, to enable health processes and activities. The successful implementation of NHI through this ETA framework is intended to benefit the country. The technical and non-technical factors that influenced the implementation of the NHI system were revealed in 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.

From a practical viewpoint, the ETA 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 ETA, 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. ETA is required to address the fundamental challenges and to enable and support NHI implementation.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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