

# **Towards an inclusive mHealth innovation framework for South Africa: A case study**

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Dissertation submitted in partial fulfilment of the requirements for the degree *Master of Health Sciences in Transdisciplinary Health Promotion* at the North-West University

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# PREFACE

The “Internet of Things” and the Fourth Industrial Revolution are impacting people’s lives whether they want them to or not. It is therefore essential to harvest the positive elements of these movements in such a way as to benefit the general public. The development of mHealth solutions should be for the people and by the people. This dissertation is an attempt to propose a framework that assures that the voices of the people are heard when finding mHealth solutions.

I want to thank Prof Adele Botha for consistently applying sufficient pressure and ensuring that this dissertation came about. You were a good “pain” in my life.

To Prof Petra Bester and Prof Awie Kotzé: Thank you for not giving up on me.

The Department of Science and Technology again proved that it is an institution enabling learning and knowledge generation. Thank you for allowing me the time to complete this work.

# ABSTRACT

Inclusive mHealth innovation aims to not only stimulate the National System of Innovation but also to unlock the mHealth development domain that is currently dominated by a select few large innovation houses. By encouraging and facilitating non-traditional innovators to co-create solutions for local needs, inclusive mHealth innovation can tap into existing lucrative markets and adopt innovations for local relevant consumption. This study set out to *identify* and *describe* the components for an inclusive mHealth innovation framework for South Africa through a case study of the *reHealthAfrica* innovation initiative.

Two scoping literature reviews were conducted. The first review was to explore and describe the components that constitute mHealth innovation for public healthcare in order to conceptualise mHealth and mHealth innovation; and to identify the components of mHealth innovation by describing their requirements, barriers and challenges. The second review was to explore the concept of inclusive mHealth innovation described and derived as a generic set of components. The study then frames these generic components with the component based approach to describe activities within an innovation ecosystem. Five components were then transposed on the findings from the scoping literature reviews and seven working hypotheses presented in a working hypothesis conceptual framework, which guided the document analysis.

The *reHealthAfrica* innovation initiative uses the Demola Innovation Model and was selected as a single, holistic case for this study. The case records included written reports and published artefacts (n=28, n=17) that reflected on the actions and activities in the *reHealthAfrica* initiative. These records are available in the public domain. An all-inclusive sample was applied after this study was approved by the Scientific Committee of the Africa Unit for Transdisciplinary Health Research (AUTHeR). The researchers confirmed that no formal ethical approval was necessary because all the data in the case records is accessible to the public via the Internet. Document analysis was conducted according to a data sheet which presented the components of an innovation system (innovations, actors and networks, knowledge and learning, relationships, institutions) and the seven working hypotheses (n=7) deduced from the first and second scoping literature reviews. Firstly inclusive innovation systems for mHealth negotiate consumer (also referring to the patient) wants and supply side needs regarding healthcare. Secondly, the inclusion of alternative and non-traditional innovators. Thirdly, to incorporate bridges and connectors early into the innovation process. Fourthly, to plan and operationalise a purposefully structured domain relevant to learning. Fifthly, to accommodate structured and informal relations; and sixthly, to develop structures that can facilitate relations which are both organic and flexible

as well as formal and contracted. The seventh working hypothesis was that those responsible for operationalising inclusive innovation initiatives to be able to feed into strategy formulation.

The document analysis evidenced the support of all of the working hypotheses and leads to a refined framework for mHealth innovation in South Africa.

**Keywords:** mHealth, inclusive innovation, conceptual framework, healthcare, South Africa

# ABBREVIATIONS

<b>Abbreviation</b>	<b>Description</b>
AUTHeR	Africa Unit for Transdisciplinary Health Research
BoP	Bottom of the pyramid
CSIR	Council for Scientific and Industrial Research
DHIE	Digital Health Innovation Ecosystem
DOAJ	Directory of Open Access Journals
DST	Department of Science and Technology
ERA	Excellence in Research for Australia
ICT	Information and Communication Technologies
IP	Intellectual Property
IPR	Intellectual Property Rights
IS	Innovation system
mHealth	Mobile Health
mLab	Mobile Applications Laboratory
NDP	National Development Plan
NSI	National System of Innovation
OECD	Organisation for Economic Cooperation and Development
PHC	Primary Health Care
RDI	Research, development and Innovation
RO	Research objectives
SMME's	Informal and small, medium and micro enterprises
SRQ	Sub-research question
STI	Science, Technology and Innovation
WHO	World Health Organisation

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# CHAPTER 1: INTRODUCTION AND BACKGROUND TO THE STUDY

## 1.1 INTRODUCTION

Health, according to the World Health Organisation (WHO) constitution, written and signed in 1946, is “...*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*” (WHO, 2006). Although this definition is still applicable today and has remained unchanged over the past seven decades, modern society has witnessed the changing face of healthcare as an essential part of life. The changes have presented themselves in the shift from curative to preventive to promotive care. The Lalonde Report published in 1974 stated that the determinants of health exist outside the healthcare system (Lalonde, 1974). The Alma Ata Declaration (WHO, 1978) declared “Health for All” based on the comprehensive care principles (to promote, prevent, treat and rehabilitate) of primary healthcare (PHC). The Ottawa Charter (WHO, 1986) introduced the concept of health promotion and the responsibility placed on society to take control of their own health. The ground-breaking World Development Report of 1993 (World Bank, 1993) initiated a greater realisation of health, agreeing that investment in health has a high rate of return, and better health improvements can be achieved if households are exposed to an enabling environment for economic growth as well as a greater diversity of healthcare products and services. Improvement of the health status of the population should be an integral part of any national strategy to reduce poverty and address inequities (Istepanian & Lacal, 2003; World Bank, 1993).

Despite encouragements by the World Bank and the WHO to advance the health statuses of populations in poor countries of the Global South; limited success has been achieved thus far. Contrary to what is currently observed in the Global South, advances in healthcare delivery systems and biomedical innovations have resulted in a dramatic reduction in global morbidity and mortality rates. These benefits, however, are unevenly distributed, with the Global North reaping most of the benefit (Global Forum for Health Research 1999). There is a clear need to revisit the vision for healthcare in the South; a change that is necessary to accommodate the transforming needs of civil society. A lack of healthcare service providers and access to adequate healthcare services, are two of the main obstacles to ensuring universal healthcare for all, and new ways of providing healthcare need to be encouraged.

Technology-driven healthcare (Kane, 2014) such as regenerative medicine, genomics, targeted therapies, medical devices, and information technology (Sharma *et al.*, 2015:1) has inevitably entered the healthcare systems, promising to improve access and quality. Mobile health or mHealth, as a form of technology-driven healthcare, is being firmly entrenched in health promotion and health informatics. The term “mHealth” is broadly defined to include the use of multimedia

devices, mobile cellular communication devices, and sensor devices, that are unified within wireless and mobile healthcare delivery systems and monitoring processes (Istepanian & Lactal, 2003). The implementation and application of mHealth has significant capacity to benefit the healthcare service delivery process, particularly in environments that are resource constrained, such as the Global South (mHealth Alliance, 2010). mHealth has evolved to include a range of well-documented strategies to meet the information needs of both the health system and the end consumer (Sezgin *et al.* 2018). Advances in other mobile technologies have additionally helped extend the scope of mHealth beyond the provision of information so that it can now improve access of services and enable self-care (Cook & Polgar, 2014; Oliver-Baxter *et al.*, 2013).

On a global scale, emerging consumer demand for mobile technology is demonstrated by the 700% sales increase in a single year, with over 6 million wearable fitness devices and smartwatches being sold in the first two quarters of 2014. In addition, Amazon supports up to approximately 9000 distinctive wearable devices, ranging in price from \$100- \$500 (Marr, 2016). South Africa is reportedly expected to be the next big contender for the smartwatch and fitness tracker market (Business Tech, 2018). This trend holds true for numerous mobile technologies beyond smartwatches and trackers, which could have a higher uptake and potential impact in the South African market. However, current opportunities to participate in this rapidly emerging market are unequal and not necessarily aligned with a need to provide universal and accessible healthcare.

While there are several key role players involved with mHealth implementation within the context of South Africa, there are only six significant stakeholders who are responsible for the vast majority of South African implementations. These stakeholders are listed as Vodacom, Mezzanine, Cell life, Praekelt Foundation, Jembi, and USAID (Botha & Booie, 2016). Unlocking the potential of mHealth innovation development would provide previously excluded innovators and developers the opportunity to participate in, and align with the ICT Research, Development and Innovation (RDI) Implementation Roadmap for South Africa (South Africa, 2012); as it leverages the advances in ICT towards benefits of a digital nature at a societal, industrial and industrial level. This will buttress the vision of the National Development Plan (South Africa, 2011) to:

- improve the quality of education, training and innovation by means of a widespread system of innovation that links key public institutions such as science councils and universities, with economic areas aligned with South Africa's economic priorities; and
- enable quality healthcare to all South Africans through enhanced patient information systems that support decentralised and home-based healthcare models.

## 1.2 BACKGROUND TO STUDY

South Africa's 2018 draft White paper on Science and Technology (Walwyn & Cloete, 2018) emphasises the importance of transdisciplinary research and knowledge and the necessity to improve the quality of life of marginalised communities in South Africa, considering that inter- and transdisciplinary research is data-driven but also considering the intersectionality of human life (South Africa, 2018:xi-xii). The updated White paper was necessary mainly because the Science Technology and Innovation (STI) benefits to expand the objectives of the National Development Plan (NDP), such as to increase healthcare access and equity, have not yet come to fruition. The main negative factors constraining the performance of the National System of Innovation (NSI) in South Africa are listed as: i) insufficient and non-collaborative nature of the STI agenda for South Africa; ii) inadequate adherence and coordination of policy; iii) poor partnerships between NSI actors, especially insufficient participation by business and civil society; iv) insufficient monitoring and evaluation of the STI efforts; v) insufficient high-level science, engineering and technical skills for South Africa's economy; vi) significant underfunding; vii) weak environments for innovation, and viii) an inadequate research system (Walwyn & Cloete, 2018:10).

It is believed that if these constraining factors can be addressed, it will be possible to increase the impact of STI in South Africa. STI also has a fundamental role to play in achieving Sustainable Development Goals, especially goal 3 (Good health and well-being). South Africa's future is undeniably connected to the future of Africa and, therefore, the STI potential for African development and continental integration needs to be fully exploited (South Africa, 2011). The changes that the Fourth Industrial Revolution can affect to introduce artificial intelligence and advances in ICT may impact the lives of ordinary people who need to be prepared for these new demands (Lamprini & Bröchler, 2018; Nguyen & Mahundi, 2019). The Fourth Industrial Revolution is based on three sets of megatrends – physical, digital and biological – and involves a convergence of technologies and disciplines towards a multisystem impact (Schwab, 2017). The key to South Africa's future resilience is understanding the likely impact of the Fourth Industrial Revolution, both positive and negative, and preparing for these both collectively and strategically (Walwyn & Cloete, 2018). It is here where innovation ecosystems can play a fundamental role to create collaborative innovation where the greater use of the Internet, digital technologies and social networks can foster learning, enable the co-creation of (codified) knowledge, and provide broad access to tools, data and resources (Lappalainen *et al.*, 2015). It allows for digital advantages to support advances in health (Iyawa *et al.*, 2017).

As Hudes (2017) indicates, digital health enables integrated care delivery through technology, allowing improved digital connectivity between patients, healthcare providers, funders and companies. Digital health improves human health through high-profile applications such as

wearable and implantable technology; web and email; mobile technology and social networking; data management and analytics (Hudes, 2017). Digital health presents a shift in the traditional view of healthcare because it places the power in the hands of the users (Lappalainen *et al.*, 2015); a process of enablement and empowerment that is true to the core of health promotion. Digital health leverages the power and reach of mobile communications to enable and reorganise health services to increase access, versatility and utility to healthcare. In the future, patients will access social health networks for information, motivation and support; will participate in self-directed and self-diagnostic healthcare; use personal sensor data exchange with physicians; and access personalised therapeutics (Hudes, 2017).

Convergences such as Ecosystem Health, Conservation Medicine, EcoHealth, One Health, and more recently, Planetary Health and GeoHealth (Aguirre *et al.*, 2019; Almada *et al.*, 2017; Whitmee *et al.*, 2015), highlight interdisciplinary and transdisciplinary research and its application to confront issues that straddle health and ecological sciences to encompass social science and policy frameworks. This transdisciplinarity is especially aligned with digital health innovation ecosystems considering that teamwork is needed to better explore, understand and address the human-animal-ecosystem health nexus (Iyawa *et al.*, 2016).

The concept of the innovation ecosystem has gained ground progressively in the literature about strategy, innovation and entrepreneurship (de Vasconcelos Gomes *et al.*, 2018). Scholars have developed a set of definitions and concepts in a variety of contexts, employing innovation ecosystem with different labels and, in some cases, with different meanings and purposes, such as: i) digital innovation ecosystem (Jiménez, 2018); ii) hub ecosystems (Jacobides *et al.*, 2018); iii) open innovation ecosystem (Chesbrough, 2003); and iv) platform-based ecosystem (Gawer, 2014). In addition, there is a renewed public debate regarding top-down policy interventions in general, suggesting they deliver only marginal success on economic development (Todes & Turok, 2018:1). There should be a strong focus on using innovation for economic growth to amplify prevailing inequalities instead of diminishing them (Chataway *et al.*, 2014). Mindful of this, an alternative innovation paradigm, such as *inclusive innovation*, is a valuable proposition to strengthen the South African innovation system, including mHealth. The term “inclusive innovation” has, however, been shaped as an extensively all-encompassing term and is often used as an oversimplified, catch-all phrase with a range of different meanings for different people (Bryden *et al.*, 2017).

### 1.2.1 The need for an inclusive innovation approach to mHealth innovation proposed

The notion of inclusive innovation advocates a shift from approaches that do not consider less advantaged participants in the processes or outcomes of the innovations; to approaches that centre the process and outcomes on all potential users (Bryden & Gezelius, 2017; Cozzens & Sutz, 2014; Foster & Heeks, 2013). Literature suggests that inclusive innovation centres on a consideration of who the participants are, and who the outcome of the innovation aims to benefit (Chataway *et al.*, 2014). In addition, it implies a way of connecting issues related to sustainability, with the concerns of places and individuals that common innovation often overlooks (Bryden & Gezelius, 2017). Chataway *et al.* (2014:39) analysed the concept of inclusive innovation and concluded that it is “*a weakly defined area of enquiry, with multiple roots and little synthetic analysis*”. As such, this research might contribute to the empirical evidence of inclusive innovation as an actionable basis for mHealth innovation in the South African context.

The current conversation around inclusion, which claims to adopt a diverse approach, is expressed in terms of quotas (i.e. those included and those who are not) and not in relation to the inequalities of a structural nature. It can be argued that the outcomes of exclusion are emphasised rather than the process. Various authors suggest that the inclusion of those who are excluded in a particular field or domain does not guarantee nor result in a forward-looking transformation of practice and knowledge (Clarke *et al.*, 2003; Epstein, 2008; Grzanka & Miles, 2016; Poutanen & Kovalainen, 2013). It is essential to extend the scope of inclusive innovation to marginalised actors and the so-called poor and disadvantaged in the Global South. Bryden *et al.* (2017) extended this interpretation and articulated the focus of inclusive innovation as those in most need of being included in a context. Ustyuzhantseva (2017) echoed these sentiments by presenting arguments to substantiate the view that subgroups are, and can be, subject to various types of exclusion. The exclusion of, for example, women as entrepreneurs, innovators and technologists, is often disregarded in prevailing innovation literature (Agnete Alsos *et al.*, 2013) and literature focussing on technology studies (Wajcman, 2000).

Unique localised challenges have to be addressed, and interventions must be approached from an inclusive innovation paradigm in order to, firstly, realise the potential of mHealth and, secondly, for it to contribute towards improved health equality in South Africa. South African mHealth solutions require the development of relevant innovative solutions, acknowledging the contextual challenges and opportunities of the South African socio-economic and cultural influences.

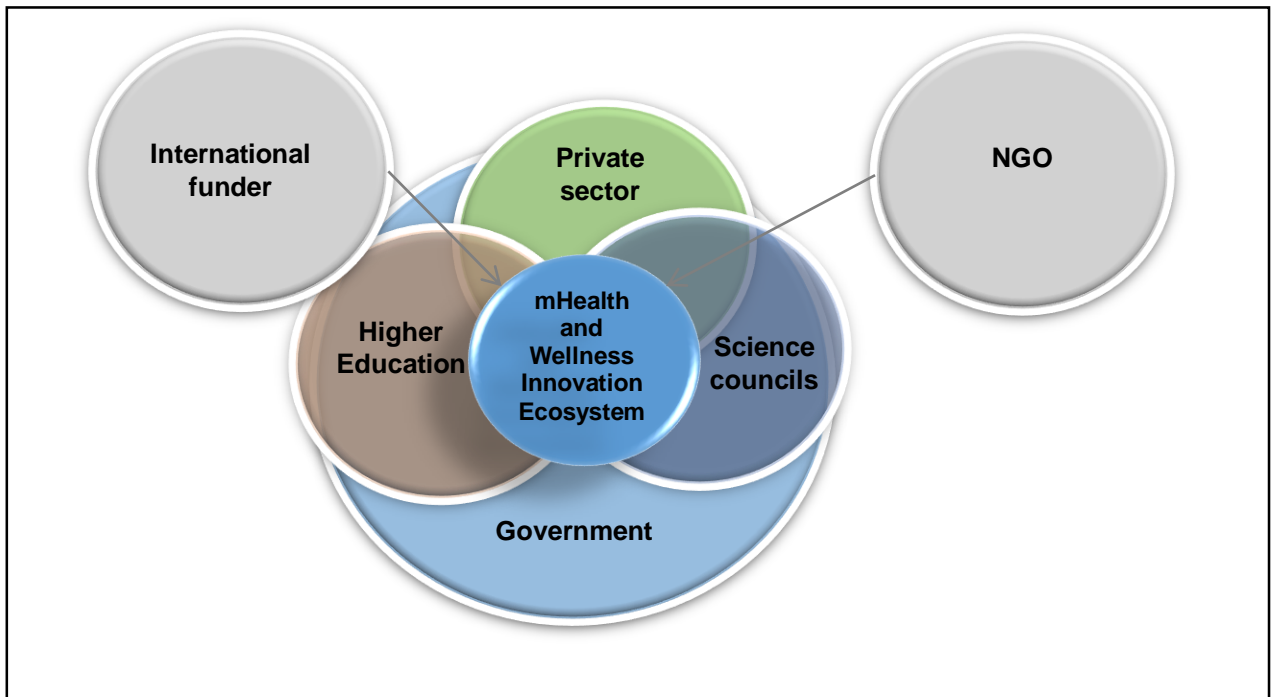
In addition to acknowledging inclusive innovation systems, this study highlights South African mHealth innovation systems that are perceived to be functioning in a silo. These viewpoints are in line with Collins (2015), who argues that inclusive innovation, as a discourse, should assess

the processes and structures that caused exclusion in the first place, examining the processes of inclusion and the systems in which the innovation acts. One such innovation is the *reHealthAfrica* initiative.

### **1.2.2 The *reHealthAfrica* initiative**

The *reHealthAfrica* initiative is presented as the context of this research. The *reHealthAfrica* initiative is a partnership between mLab Southern Africa, the Council for Scientific and Industrial Research (CSIR) and the Department of Science and Technology (DST) (mLab, 2019). The *reHealthAfrica* initiative was launched in Cape Town in 2016, to not only validate the Digital Health Innovation Ecosystem (DHIE), but to stimulate the mHealth and Wellness Innovation Ecosystem (Herselman & Botha, 2017:139) and to demonstrate that such an ecosystem can benefit and add value to stimulate the National System of Innovation in South Africa through the promotion of an innovation culture (Herselman & Botha, 2017:146).

The notion of a Digital Health Innovation Ecosystem was instantiated as the mHealth and Wellness Innovation Ecosystem. Figure 1-1 (below) illustrates *reHealthAfrica*'s positioning within the South African National system of innovation. The *reHealthAfrica* initiative was conceptualised from a strategic opportunity within the mHealth and Wellness application development space and the conceptualisation of a Digital Health Innovation Ecosystem (DHIE). The instantiation evaluated various existing innovation models and strategies. A criterion for the selection of an existing innovation model or strategy was that it would have to bolster the creation of an innovation ecosystem. Activities would need to extend to include industry, higher education and other stakeholders to co-create around new ideas and concepts. The Demola innovation model (Demola Global, 2019) was selected because of its proven track record of Intellectual Property Rights (IPR) generation and its established link with a broader international innovation network (Botha *et al.*, 2017:145-147).



**Figure 1-1: reHealthAfrica within the South African National System of Innovation (Herselman *et al.*, 2016:146)**

The process followed by Demola can be described as the Demola innovation model. Demola has formed an international network using geographically localised Demola Innovation Centres. Their footprint, which extends to 16 countries, is associated with more than 50 international universities and is incorporated into over 250 under- and postgraduate programmes. Demola’s extended portfolio includes collaboration with an excess of 600 companies and has delivered 70% of the global licensing rate (Demola Global, 2019).

As such, learning and implementing through local adaption would be an invaluable asset in the local innovation system. A South African mobile solutions laboratory and start-up accelerator, mLab South Africa (Kotze, 2016), was selected as an implementation partner. mLab’s substantial experience and presence in the mobile application development environment in South Africa provides a natural home for entrepreneurs and mobile developers (Botha, 2016; Herselman *et al.*, 2016) as their innovation focus provides continuity and ensures sustainability beyond the duration of initiatives.

The first season was held in Cape Town in 2016, and a total of 30 students from multiple disciplines were involved. The students were predominantly from two major Cape Town universities (University of Cape Town and Cape Peninsula University of Technology). The group comprised of 84,2% males and 15,8% females ranging from 18 years to 24 years (with 20-year-olds being the majority at 32%). The following hackathons were facilitated:

- Youth-driven mHealth and Wellness Challenge 1: codeX Developer Graduation Hackathon; (CodeX is a youth skills development programme supported by mLab);
- Youth-driven mHealth and Wellness Challenge 2: Geekulcha Vacation Work Programme for Geekulcha youth, trainers and facilitators (Geekulcha is a mLab-hosted youth engagement platform with the aim of increasing awareness and interest in ICT and Science).

The implementation, evaluation and adaptation of the Demola model to suit local challenges and opportunities led to the creation of the *reHealthAfrica* brand. The brand was launched on an integrated digital and social media framework consisting of:

- the www.reHealthAfrica.com domain; and
- content creation extensions on Twitter, Instagram, Facebook, LinkedIn and Storify.

The launch represented the first phase of the brand implementation, presenting *reHealthAfrica* as an initiative all about **reEngineering, reThinking, reimagining** and doubling efforts to unlock the potential of mHealth and medTech” (Botha, 2016:32).

### 1.3 PROBLEM STATEMENT, RESEARCH QUESTIONS, AIM AND OBJECTIVES

#### 1.3.1 Problem statement and research questions

South Africa has a significant adoption of mobile technology. However, despite this and the documented potential of the role of mHealth, evidence of broad scale inclusion and innovation of mHealth solutions within the healthcare sector in South Africa is sporadic. There have been various innovation initiatives in South Africa with multiple stakeholders proclaiming to follow a participatory approach. Yet isolated and exclusive development of mHealth innovation remains the status quo. The conceptualisation of the *reHealthAfrica* initiative created the first platform for inclusive mHealth innovation development within the general health domain in South Africa. In the presence of fragmented mHealth innovation, an inclusive mHealth innovation framework can provide the necessary impetus to enhance mHealth development within the South African healthcare system. It is argued that reflecting on and describing the initiative can contribute to a conceptual framework for inclusive mHealth innovation in South Africa.

To operationalise this intention, the main research question (MRQ) for this study was articulated as follows: *What are the components that constitute a framework for inclusive mHealth innovation in South Africa?* The following sub-research questions (SRQs) were outlined:

- SRQ 1: What components constitute a mHealth innovation system?
- SRQ 2: What do inclusive innovation systems in mHealth entail?
- SRQ 3: How can inclusive mHealth innovation be realised in South Africa?

### 1.3.2 Aim and objectives

This research aims to identify and describe the components of an inclusive mHealth innovation framework for South Africa. The research objectives (RO) are outlined below linked to relevant sub-research question (SRQ):

**Table 1-1: Research questions and objectives**

Research question	Research objective
Q1: What components constitute a mHealth innovation system?	RO1: To explore and describe components that constitute mHealth innovation for public healthcare from literature towards: <ul style="list-style-type: none"><li>• conceptualising mHealth and mHealth innovation;</li><li>• identifying the components of mHealth innovation through a description of the requirements, barriers and challenges.</li></ul>
Q2: What do inclusive innovation systems in mHealth entail?	RO2: Describe what inclusive innovation in mHealth entails from literature and derive a generic set of components.
Q3: How can inclusive innovation in mHealth be realised in South Africa?	RO3: Refine the generic set of components for inclusive mHealth innovation for the South African context using a case study.

## 1.4 CENTRAL THEORETICAL STATEMENT

Despite a strong mobile technology user base in South Africa, only isolated instances of mHealth are evident. The study argues that the potential for mHealth has not been realised and that the latter remains exclusive and sporadic within the healthcare in South Africa. The *reHealthAfrica* initiative presents the first digital health and wellness ecosystem in South Africa, bringing together critical role players from outside of the few mayor role-players towards strengthening mHealth innovation.

A framework to support inclusive mHealth innovation in South Africa can serve as an ideal impetus to strengthen mHealth. The researcher argues that a comprehensive literature review was able to facilitate the identification of components for an inclusive mHealth innovation framework. Exploring and describing the single case of the *reHealthAfrica* initiative, through document analysis of the case record, and guided by the components identified in the literature study, could enable the researcher to propose, refine and contextualise an inclusive mHealth innovation framework for South Africa.

## 1.5 PARADIGMATIC ASSUMPTIONS

Denzin and Lincoln (2005) suggest that any research is grounded in assumptions that provide a framework for the research activities. They argue that all research is “guided by the researchers’

set of beliefs and feelings about the world and how it should be understood and studied". Burrell and Morgan (2005) describe a research paradigm as being framed by a regulation perspective and the continuum related to objective and subjective views. Objectivism considers reality as independent of human perception, while subjectivism holds that reality, in and of itself, is a human construct (Burrell & Morgan, 2005; Goles & Hirschheim, 2000; Saunders *et al.*, 2016). The latter frames views on the assumptions about knowledge (epistemological assumptions), those related to how knowledge is acquired or the nature of reality (ontology), and assumptions on how this knowledge is communicated, or the role of values (axiology).

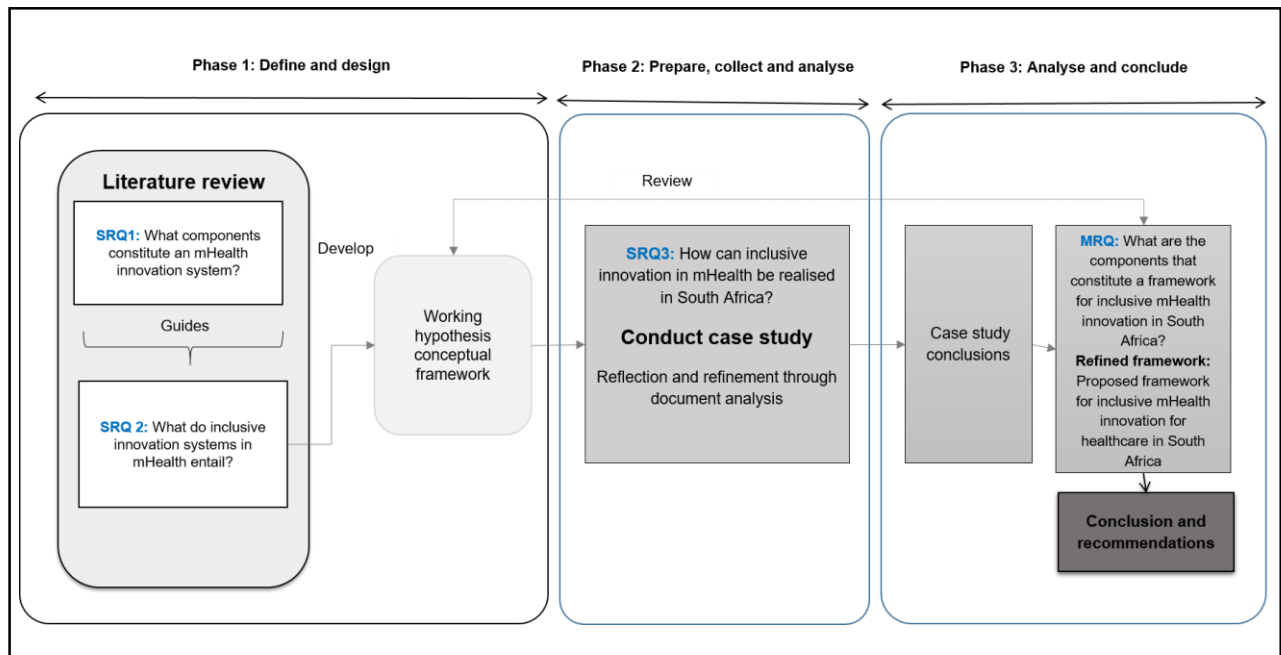
This study advocated a change to the status quo; as such it is positioned as *advocating change and emancipation* in the Burrell and Morgan (2005) regulation-radical change continuum. Being positioned in a *radical structuralism* paradigm means that the research is concerned with "power relations and patterns of conflict" (Saunders *et al.*, 2016:135). The implications for this study would be to understand structural patterns (hierarchies and relationships) which cause the status quo and for identifying actions that can influence the phenomena.

## **1.6 RESEARCH METHODOLOGY**

The research methodology is presented in *three phases*, aligned with the case study process by Yin (2013), presented in figure 1-2 (below). A single, holistic case of the *reHealthAfrica* initiative was adopted towards answering the main research question (Section 1.3.1).

### **1.6.1 Phase 1: Define and design**

In Phase 1, the theoretical assumptions to direct the case study were formulated following a qualitative, explorative, descriptive and contextual design (Botma *et al.*, 2010:188). Phase 1 consisted of a comprehensive literature study that followed the steps of a scoping review, and is presented over two chapters.



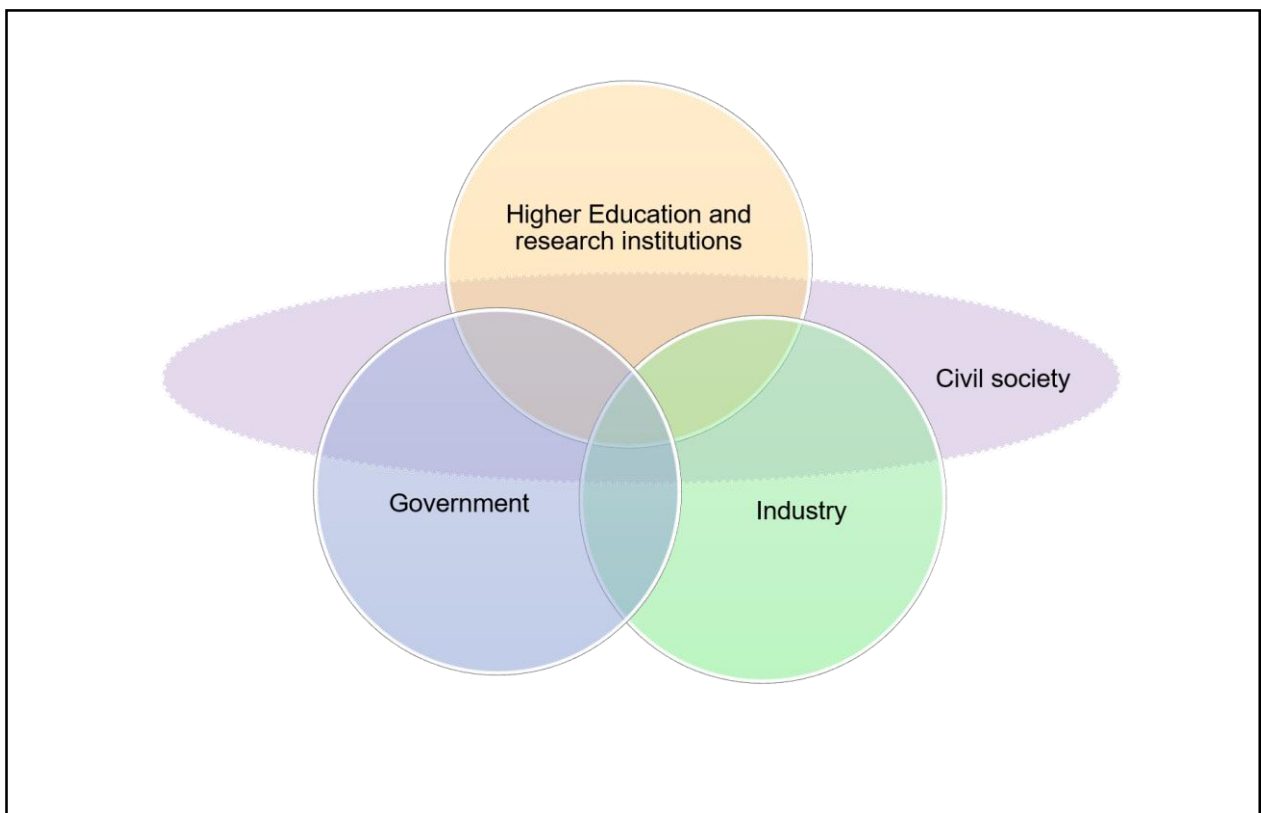
**Figure 1-2: The proposed phases of the research according to the case study process by Yin (2013)**

The scoping reviews were grounded in the methodology of Bergek *et al.* (2008); Hekkert *et al.* (2007) as summarised by Van der Merwe (2018) to enumerate two different approaches in literature for the description of innovation systems, namely, a component-based approach and a function-based approach. A component-based (or structural) approach was adopted for this study. It entailed the identification of system elements (such as all the actors, institutions and organisations within the system) and a description of the relations between them (Hekkert & Negro, 2011) (see Scope and limitations). Such an approach is used as a descriptive rather than an analytical outline. The component-based approach emanates from several authors such as Freeman (1987), Edquist and Johnson (1997), Nelson (1993), and Foster and Heeks (2013) who described five core structural components of an innovation system. These components are: innovation; actors and networks; knowledge and learning; relations; and institutions.

Foster and Heeks (2013) argued that the component of innovation in innovation systems is supply-side driven and orientated towards growth. Actors are the components involved in innovation activities such as health professions training within higher education, science councils and other stakeholders. A distinction is made between organisations and institutions. Institutions refer to formal entities such as regulations, standards and laws and informal entities such as, but not limited to culture, tradition, norms and codes of conduct. Organisations, on the other hand, are conceptualised as entities made up of individuals with a shared vision (North, 1994). These structural components of an innovation system (IS) were the foundation of the exploration on how actors and institutions in a mobile innovation system function in partnership to exchange knowledge to develop, produce and diffuse mobile innovations. This is in line with the same

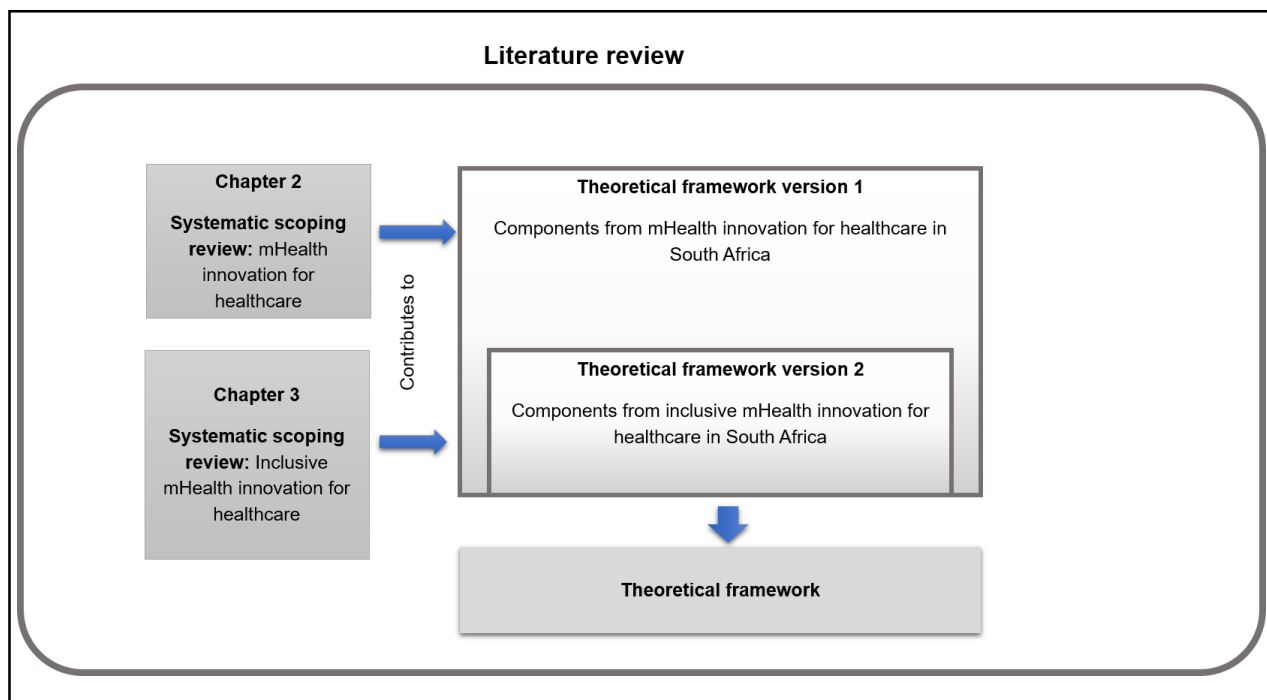
approach adopted by Foster-Fishman *et al.* (2007), Foster and Heeks (2013) and Chataway *et al.* (2014).

Within the context of this study, it is important to note the role of the National System of Innovation (NSI) within South Africa (South Africa, 2019) and how it plays out in reality. The actors within the NSI form the quadruple helix of innovation (Afonso *et al.*, 2012; McAdam & Debackere, 2018) that consists of i) higher education and research institutes; ii) industry (in some cases also called firms); iii) government, and iv) civil society (or the public at large) and it is essential to also consider the impact of the innovation helix on economic growth. The quadruple helix of innovation is an underlying concept in inclusive innovation, as presented in figure 1.3 hereafter.



**Figure 1-3: Quadruple helix of innovation**

The first scoping review explored mHealth innovation in South African and grounded the second scoping review. The second review focused on *inclusive* mHealth innovation for healthcare in South Africa. The conclusions of both reviews informed the conceptual framework as an input to Phase 2.



**Figure 1-4: Scoping review outline for chapters 2 and 3**

A scoping review is described as a specific type of literature review characterised by a structured process of mapping key concepts within a body of knowledge (Arksey & O'Malley, 2005; Armstrong *et al.*, 2011). Accordingly, it can be viewed as a more flexible alternative to a systematic review. Although there is no formally accepted definition for a scoping review, several authors have jointly contributed to an acceptable methodology for conducting such an endeavour, either as part of a larger initiative or as a standalone venture (Arksey & O'Malley, 2005; Davis *et al.*, 2009; Levac *et al.*, 2010; Peters *et al.*, 2015; Peterson *et al.*, 2017).

The two scoping reviews were used to uncover the main concepts included in an inclusive mHealth innovation framework. These two reviews aimed to adopt the substantive, as well as some aspects of the methodological rigour associated with systematic reviews to enhance the quality of findings. Only peer-reviewed academic text was used to add an additional level of rigour. The scoping reviews are presented using the steps suggested by Arksey and O'Malley (2005), summarised as:

- **Step 1:** Identified the research questions: which domains need to be explored? The first review (Chapter 2) explored all available literature on mHealth innovation and the second review (Chapter 3) focused specifically on inclusive mHealth innovation. The reason for both searches on both topics was to first establish a broad view of mHealth innovation as there is more literature related to mHealth innovation because the South African eHealth strategy was published in 2002. The second search revealed the nature of inclusive mHealth innovation and brought a new dimension that enriched the second review.

- **Step 2:** Found relevant studies by means of electronic databases, reference lists, conference proceedings, and others. Step 2 was conducted using the search engines and databases provided by the Ferdinand Postma Library of the North-West University and the Department of Science and Technology’s knowledge centre.
- **Step 3:** Selected studies relevant to the research questions and predefined inclusion criteria (Table 1-2).
- **Step 4:** Extracted data from the selected studies. Data extraction occurred through a summary of findings table.
- **Step 5:** Analysed, synthesised and reported results.

Although presented as a linear process, this study iteratively revisited activities presented in each step deemed necessary to adequately address the research aim. The lists used in this search were sourced from the Norwegian Register (Norwegian Centre for Research Data, 2019), The Excellence in Research for Australia (ERA)(Australian Research Council), PubMed (US National Library of Medicine National Institutes of Health), and Directory of Open Access Journals (DOAJ)(Directory of Open Access Journals (DOAJ)). DOAJ is a community-curated online directory that indexes high quality, open access, peer-reviewed journals. All of these lists are curated entities that ensure that high-level research is published. In addition, the study includes peer-reviewed books, book chapters and conference proceedings.

Chapter 2 addresses SRQ 1 and presents a scoping review on mHealth innovation in South Africa. The outcome of this chapter was the identification and articulation of the components of mHealth innovation for healthcare in South Africa and delivers a first version of the conceptual framework. Chapter 3 is concerned with SRQ 2. The chapter interrogates literature on inclusive mHealth innovation through a scoping review to articulate the components of inclusive innovation and delivers the second version of the conceptual framework. This engagement was guided by the components identified in Chapter 2.

**Table 1-2: Summary of search process for each chapter in the literature review**

TOPIC	CHAPTERS	
	Chapter 2: mHealth innovation for healthcare	Chapter 3: Inclusive mHealth innovation for healthcare
Keyword searches	“Mobile Health Innovation”; “mHealth Innovation”; “mHealth”; “Innovation”; “Mobile Health”; “Digital Health Innovation”	“Inclusive Innovation”; “Inclusive Health Innovation”; “Inclusive Digital Health Innovation”
Literature review method	Scoping	Scoping
Databases used	Scopus, IEEE Xplore, Wiley Online Library, Web of Science, Science Direct	Scopus, IEEE Xplore, Wiley Online Library, Web of Science, Science

		Direct as well as selected reports from credible institutions.
Inclusion and exclusion principles	<ul style="list-style-type: none"> <li>• Only publications written in English were used.</li> <li>• Studies including frameworks and models of mHealth were included.</li> <li>• Studies detailing Innovation System were included.</li> <li>• Exclusion criteria were medical innovations or interventions that were considered medically innovative rather than technologically innovative; Clinical studies; Mobile Health where mobility referred to being able to move as opposed to the portability of the device.</li> <li>• Publications of which the full text could not be accessed.</li> </ul>	<ul style="list-style-type: none"> <li>• Only publications written in English were used.</li> <li>• Studies including frameworks and models of inclusive innovation and inclusive innovation ecosystems were included.</li> <li>• Studies detailing Innovation Ecosystem were included.</li> <li>• Exclusion criteria were medical innovations or interventions that were considered medically innovative rather than technology innovative and clinical studies.</li> <li>• Publications of which the full text could not be accessed.</li> </ul>
Number of papers used	28 (n)	17 (n)

This study used a set of derived working hypotheses developed from the conclusions from the scoping review in Chapters 2 and 3, as a conceptual framework for inclusive mHealth innovation in South Africa. Shields and Tajalli (2006) made a case for using a conceptual framework to provide coherence to empirical research, with a working hypothesis conceptual framework as one of a number of such conceptual frameworks.

Shields and Tajalli (2006) further argued that working hypotheses are an interim means to advance further inquiry. In contrast to formal hypotheses, working hypotheses are statements of expectations. These statements cannot be proven but are either substantiated or invalidated by evidence. In this study, scoping literature reviews are presented towards identifying the components that constitute inclusive mHealth innovation (Chapter 2 and 3). A set of working hypotheses were formulated to refine these elements towards the components that constitute a framework for inclusive mHealth innovation in South Africa. Through the working hypotheses conceptual framework, empirical data was collected through a single, holistic case study of the *reHealthAfrica* initiative in Phase 2. Thereafter assertions were made as to the legitimacy of the hypotheses in Phase 3.

### 1.6.2 Phase 2: Prepare, collect and analyse

Defined by Yin (2009:18), a case study is “an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident” as opposed to carrying out the experiment in a

controlled environment such as a laboratory. Olivier (2009) noted that a case study research strategy allows for an exhaustive evaluation as compared to other techniques. It allows the researcher to interrogate the identified components in details to describe a particular phenomenon. In phase 2, the five components of designing a case study by Yin (2013) are presented, namely the case study question, propositions, units of analysis, the logic linking of data with the propositions and criteria for interpretation of the findings. The case study question posed was “How can inclusive mHealth innovation be realised in South Africa?”

**1.6.2.1 The case**

A single case, holistic strategy (Yin, 2003) was proposed. A single case was representative to the mHealth and innovation arena in South Africa. It was also a critical case to test the constructed conceptual framework in phase 1 (Botma *et al.*, 2010:191). The single case presented case records in the form of documents (Botma *et al.*, 2010:192).

**1.6.2.2 Theoretical propositions for the case study**

The following theoretical propositions were stated: the case study was based on the proposed conceptual framework for inclusive mHealth innovation in South Africa (from the scoping reviews); not to validate the DHIE but to understand the mHealth and Wellness Innovation Ecosystem (Botha *et al.*, 2017:139).

**1.6.2.3 Case records and data sources**

Data sources in this case referred to various documents available within the public domain. A case study strategy presented the researcher with an opportunity to use documents to answer the research questions (Cohen *et al.*, 2007; Creswell, 2014).

**Table 1-3: Summary of data collection strategies and analysis methods**

RESEARCH QUESTION		CASE STUDY		
		Data collection		Data analysis
		Scoping review	Document analysis	
<b>Sub-research question 1</b>	What components constitutes a mHealth innovation system?	✓		Inductive, deductive
<b>Sub-research question 2</b>	What do inclusive mHealth innovation systems entail?	✓		Inductive, deductive
<b>Sub-research question 3</b>	How can inclusive mHealth innovation be realised in South Africa?		✓	Document analysis

### 1.6.2.3.1 Working hypotheses

Working hypothesis, as described by Dewey (1938:142); in his Theory of Inquiry is a “provisional, working means of advancing investigation”; leading to the uncovering of other insights. The working hypotheses in this study was the structure from the findings of the scoping reviews mapped to the core components as discussed in section 1.6.1.

### 1.6.2.3.2 Document analysis

Babbie (2005) outlined the notion of document analysis and argued that, for instance, it is appropriate for answering research questions within social sciences research. Document analysis research involves the scrutiny of social artefacts. Babbie (2005:304-305) further listed some of the suitable items for use as: books, magazines, Web pages, poems, newspapers, songs, paintings, speeches, letters, e-mail messages, bulletin board postings on the Internet, laws, and constitutions.

Documentation is considered a robust source of data as it can be appraised repetitively. Yin (2013) argued that such a review is discreet, exact, and covers an extended period. However, he noted that retrievability and access, biased selectivity, and reporting bias are some of the challenges that a researcher needs to negotiate. Retrievability and access are considered negligible as all the documents are in the public domain and readily accessible. However, *biased selectivity* and *reporting bias* are noted.

Document analysis was conducted as case record (Section 4.1). The following *reHealthAfrica* documents (Table1-4) were included in the case record through an all-inclusive sampling strategy:

**Table 1-4: Documents used in the case record**

DOCUMENT	BRIEF DESCRIPTION
Presentation to stakeholder	Project summary for submission to the project manager at the CSIR.
Presentation to stakeholder	EU-GBS: eHealth Integration Platform: DST Steering committee presentation. 1 Dec 2015
DreamGirls Hackathon report	mLab Southern Africa in partnership with the CSIR hosted a DreamGirls International Outreach and Mentoring program in Cape Town. The theme of the workshop was “Health and Wellness.” The purpose of the workshop was to educate teenage girls about Feminine Hygiene and Feminine Health towards the establishment of a learning ecosystem.
Codex Hackathon Report	The CSIR and mLab hosted an mHealth and Wellness hackathon at Workshop 17 in the V&A Waterfront in Cape Town. The purpose of the hackathon was to design and build innovative solutions in the mHealth and Wellness space.

DOCUMENT	BRIEF DESCRIPTION
Flyer	Flyer to promote the 2016 Cape Town mLab Demola mHealth Season powered by the CSIR Meraka Institute and Department of Science and Technology.
One 2017 project report	Short summary and preamble for the innovation that would take place.
Published Conference paper	Contextualisation: An exercise in Knowledge Management and Transfer. A conference paper that was presented IFKAD 2017 - International Forum on Knowledge Asset Dynamics in St Petersburg, Russia. (Botha <i>et al.</i> , 2017)
Published Conference paper	The value of co-creation through Design Science Research in developing a Digital Health Innovation Ecosystem for South Africa (Herselman & Botha, 2017).
One monitoring and evaluation report	A review of the mHealth and Wellness ecosystem and innovation culture development programme within the EU-GBS Meraka programme and implemented during FY2016.
An interim project report from the <i>reHealthAfrica</i> team	mHealth and Wellness Innovation Ecosystem Component of the EU-GBS Major Highlights for 2015/16.
Book chapter. Chapter 8: mHealth and Wellness Innovation Ecosystem; in "Strategies, approaches and experiences towards building a SA health innovation".	The purpose of the book is to provide an overview of how a Digital Health Innovation Ecosystem (DHIE) was developed based on different strategies, approaches and experiences over a period of time, and based on collaborations between the Council for Scientific and Industrial Research (CSIR) and VTT, known as the Technical Research Centre of Finland.

As these documents were all within the public domain, no formal ethical approval was required.

### 1.6.2.3.3 Gauging the evidence

The working hypotheses were used to critically analyse the documents towards answering SRQ 3: How can inclusive mHealth innovation be realised in South Africa? The evidence collected was gauged as strong support, adequate support or limited support for each working hypothesis. These three levels of support are described as follows:

- *Strong support*: Concrete support for the working hypothesis from documentation;
- *Adequate support*: The working hypothesis was indirectly supported or inferred in documentation;
- *Limited support*: The working hypothesis was vague or not supported or inferred in the documentation.

A coding sheet was developed from the working hypotheses and used to analyse the documentation:

**Table 1-5: Coding sheet**

Working hypothesis (WH)	Document reference	Relevant text	Nature of support
WH 1: Inclusive mHealth innovation systems negotiate consumer wants and supply-side needs with regards to healthcare.			
WH 2a: Alternative non-traditional innovators are included.			
WH2b: Bridgers and connectors are incorporated early on in the innovation process.			
WH 3: Purposefully structured domain-relevant learning is planned and operationalised.			
WH 4: Structured as well as informal relations are accommodated.			
WH 5a: Structures are developed to facilitate relations that are, on the one side organic and flexible, and on the other formal and contracted.			
WH 5b: Those responsible for operationalising inclusive innovation initiatives are able to feed into strategy formulation.			

The data was interpreted by the researcher and as such, the data analysis was a qualitative interpretive exercise applying hermeneutics. Schmidt (2016) described hermeneutics as a way to interpret text and it is concerned with theories for correctly interpreting text. This is in line with Yin (2013:310) who presents hermeneutics as the aspect of a study that involved “interpreting the event(s) being studied to deepen the understanding of the political, historical, sociocultural, and other real-world contexts within which the event(s) occur(s)” (Yin, 2013:310). Hermeneutics recognises social realities and interprets the meanings (Brannick & Coghlan, 2007). The following table presents the application of fundamental principles of hermeneutics, as described by Klein and Myers (1999), to this study.

**Table 1-6: The fundamental principles of hermeneutics application to this study**

FUNDAMENTAL PRINCIPLES	APPLICABILITY TO THIS STUDY
Hermeneutic Circle: Human understanding is derived through iterating between the parts and the whole (Klein & Myers, 1999).	An understanding was created by using different sources of data including two scoping literature reviews.
Contextualisation: Understanding the current situation in the light of what emerged from the past (Klein & Myers, 1999).	The study highlighted the ways in which inclusive mHealth innovation could be realised, both in process and outcome.

FUNDAMENTAL PRINCIPLES	APPLICABILITY TO THIS STUDY
Dialogical reasoning: Revising the differences that arise from the theoretical preconceptions to the data actually collected (Klein & Myers, 1999).	The researcher iteratively revised the data to interpret the discrepancies between the conceptual framework and the actual framework.
Multiple interpretations: Requires accounting for different interpretations by participants (Klein & Myers, 1999).	Different interpretations were applied to account for differences.
Suspicion: Understanding to possible “biases” and “systematic distortions” in data collected (Klein & Myers, 1999).	Bias was outlined and acknowledged.

### 1.6.3 Phase 3: Analyse and conclude

In the final phase, documented in Chapters 4 and 5, the refined framework for inclusive mHealth innovation is presented and conclusions are articulated. The study narrative concludes with Chapter 5.

#### 1.6.3.1 Logic models and criteria to interpret the findings

The researcher operationalised pattern matching, as described by Yin (2013:159), through the working hypothesis to link the data to the declared propositions (section 1.6.1).

#### 1.6.3.2 Rigour

Specific strategies were maintained throughout the research process to enhance the quality of the research, based on Botma *et al.* (2010:230-234). To enhance confirmability, multiple sources of evidence were used, namely two scoping literature reviews and the case records (which included various different types of documents) as this established a chain of events.

Credibility was increased through pattern matching the conceptual framework’s working hypotheses and the results from the case study. The scoping reviews and the results from the case study were triangulated. In addition, the researcher had prolonged engagement with the case study, *reHealthAfrica* initiative, was familiar with the documents being analysed, and reflected regularly on the research process. The transferability of the research was increased through the two scoping literature reviews, which concluded into a conceptual framework. Finally, dependability was enhanced by following a comprehensive and pre-approved case study protocol. An audit trail was established through rigorous recording of the realised data collection and analysis, and by developing a database.

## **1.7 ETHICAL CONSIDERATIONS**

This research will follow strict ethical guidelines as set out by the National Health Research Ethics Council in order to ensure that rights of all participants are protected. The research will adhere to the following principles adapted from literature (Berg *et al.*, 2012; Flick, 2014; Ritchie *et al.*, 2013):

## **1.8 ETHICAL CONSIDERATIONS**

The National Commission for the Protection of Human Subjects of Biomedical and Behavioural Research (1978) compiled the Belmont Report which describes the three principles relevant to research involving human participants. These three principles are beneficence, justice and respect. In addition, the Department of Health (2015) further highlights the broad ethical principles of beneficence and non-maleficence, distributive justice through equality, and respect for persons through dignity and autonomy.

### **1.8.1 Beneficence and non-maleficence**

This study used only secondary information available within the public domain. The research was not of a sensitive nature and therefore did not cause any harm.

### **1.8.2 Justice, distributive justice and equity**

The identification and selection of the *reHealthAfrica* initiative case study was justified as the ideal and only example to be included in this study.

### **1.8.3 Respect, dignity and autonomy**

The researcher did not have any direct contact with human participants and, therefore, there was no process of ensuring autonomy and self-determination.

### **1.8.4 Relevance and value**

The relevance and value of this research lies in the fact that there is currently a high mobile usage profile within South Africa, yet there is a lack of inclusive mHealth innovation. In the absence of significant mHealth success, especially within the South African public healthcare domain, an inclusive mHealth innovation framework is presented as a contribution to the existing body of knowledge.

### **1.8.5 Scientific integrity**

This research design was approved by the Scientific Committee of the Africa Unit for Transdisciplinary Health Research (AUTHeR) and it can therefore be confirmed that the proposed methodology was appropriate to address the research questions.

### **1.8.6 Conflict of interest**

The researcher is employed by the South African Department of Science and Technology and participates in the *reHealthAfrica* initiative.

## **1.9 SCOPE AND LIMITATION OF THE STUDY**

This study was conducted to contribute towards the unlocking of a domain that is currently dominated by only a few actors. It was envisaged that the study could additionally enhance the understanding of inclusive mHealth innovation in order to inform relevant policy and strategies to enable additional actors to participate in a meaningful manner.

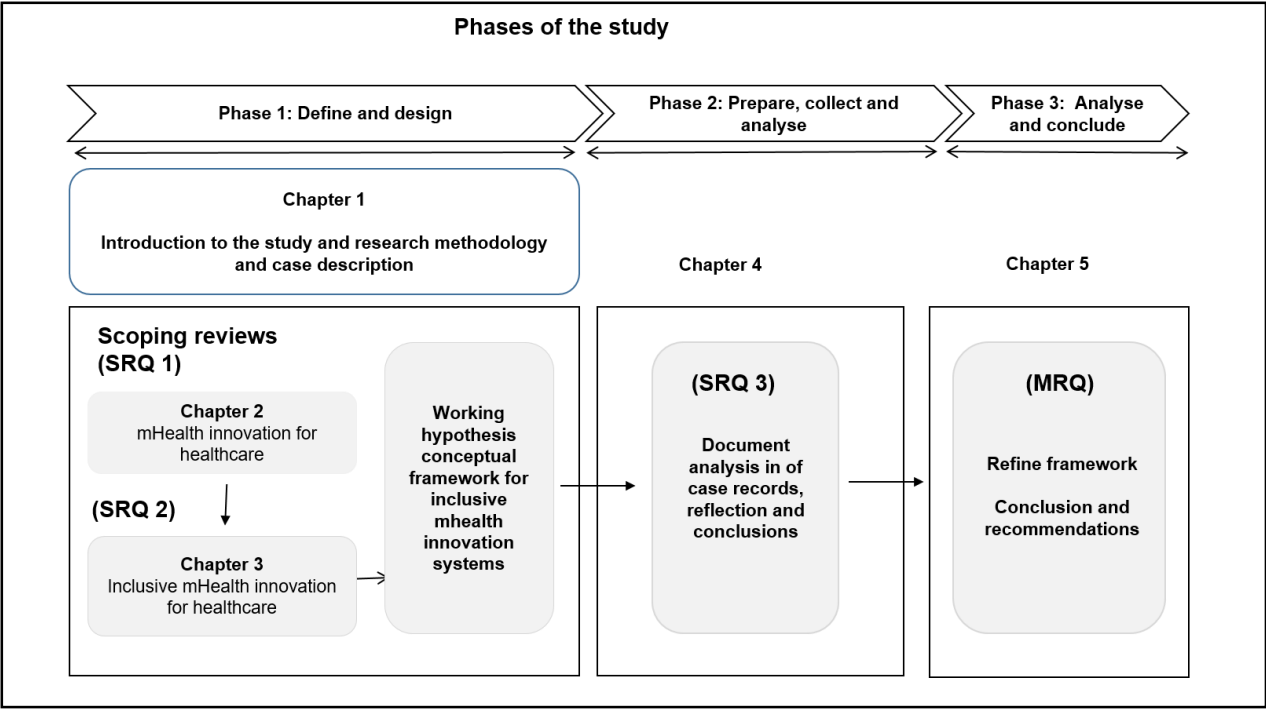
The study was a single snapshot in time, and the purposeful sampling of the case record (analysed documents) are acknowledged to enact some bias. Yet, this bias was mitigated through data triangulated as two scoping reviews were also conducted.

It is acknowledged that all descriptions of systems are simplifications (Edquist, 2001) and that there was personal bias in abstracting events. The component-based approach of analysing an innovation system was complementary rather than exclusive. Given the limited scope of a dissertation, the function-based approach was not included.

Most of the definitions for inclusive innovation considered innovation as being 'new'. This study argues that any innovation available in the developed world, implemented in a developing context as an exaptation of known ideas, can be considered as inclusive innovation (Gregor & Hevner, 2013).

## **1.10 STUDY OUTLINE**

This section presents the structure of the dissertation and provides a brief overview of what the focus for each chapter. This is depicted in Figure 1-5.



**Figure 1-5: Structure of the dissertation**

Chapter 1 provides the background, introduces the reader to the study and narrates the research methodology. Chapter 2 presents a scoping literature review (Grant & Booth, 2009) of mHealth innovation. It focuses on the conceptual principles and key components of mHealth and considers conceptualising mHealth innovation. Chapter 3 introduces and contextualises inclusive mHealth innovation whilst Chapter 4 outlines the realisation of the case study with the focus on document analysis and presents case reflections for consideration in refining the conceptual framework for inclusive mHealth innovation in South Africa. Chapter 5 provides a synthesis of the findings and concludes the dissertation, offering an overview of the key aspects of the study in terms of revisiting the research questions and their answers, drawing conclusions based on the research findings. The chapter presents recommendations and highlights the main contributions and limitations of the study, while it also hints at possible future research work emanating from this study.

# CHAPTER 2: mHEALTH INNOVATION IN SOUTH AFRICA

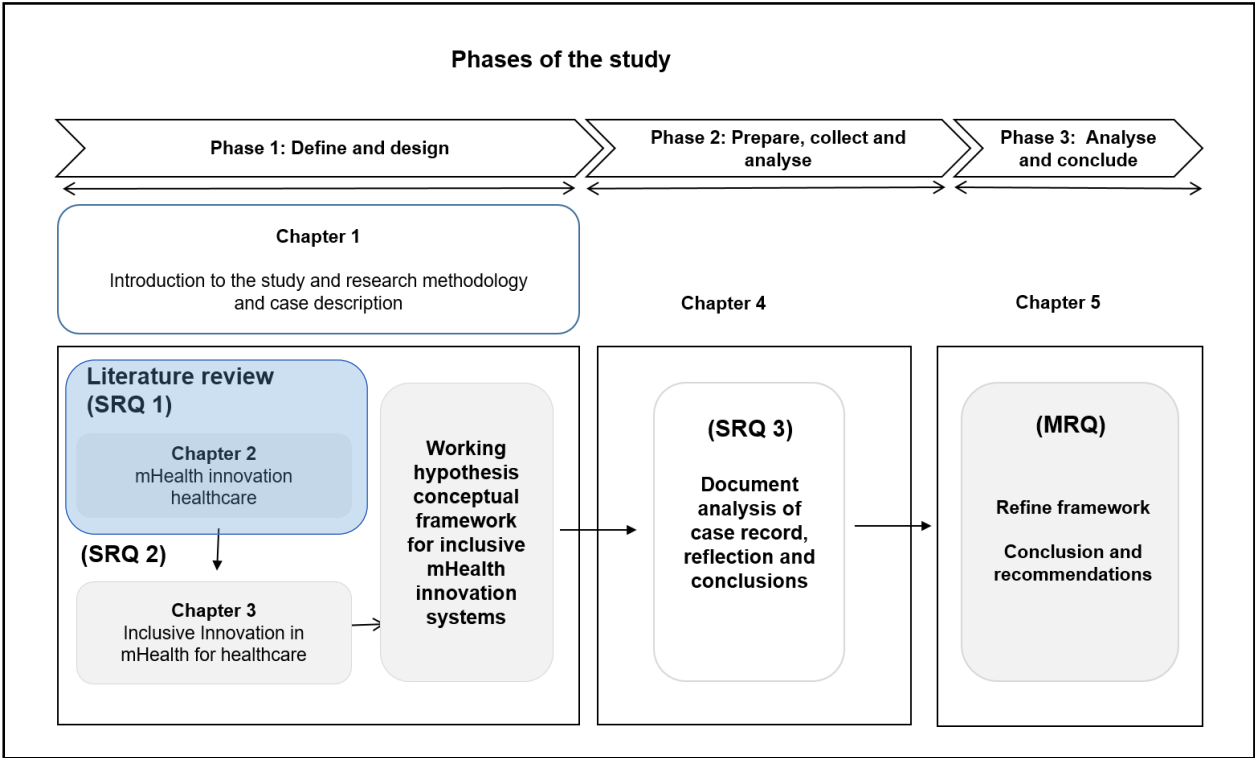


Figure 2-1: Phases of the study relevant to Chapter 2

## 2.1 INTRODUCTION

The term mHealth is a broad conceptualisation for the use of mobile cellular communication devices, multimedia devices and sensor devices used in wireless healthcare monitoring and delivery systems (Istepanian & Lacal, 2003). International emerging consumer demands are demonstrated by the vast uptake of personal wearable technology and the use of an ever-increasing selection of mobile applications. In South Africa, the high mobile penetration rate and existing mobile user base has been alluded to as the next big market for smartwatches and fitness trackers (Business Tech, 2018). Unlocking the potential of mHealth innovation development would provide innovators and developers with new opportunities to participate in these developments. In addition, the contributions of local innovators are essential for developing locally relevant applications.

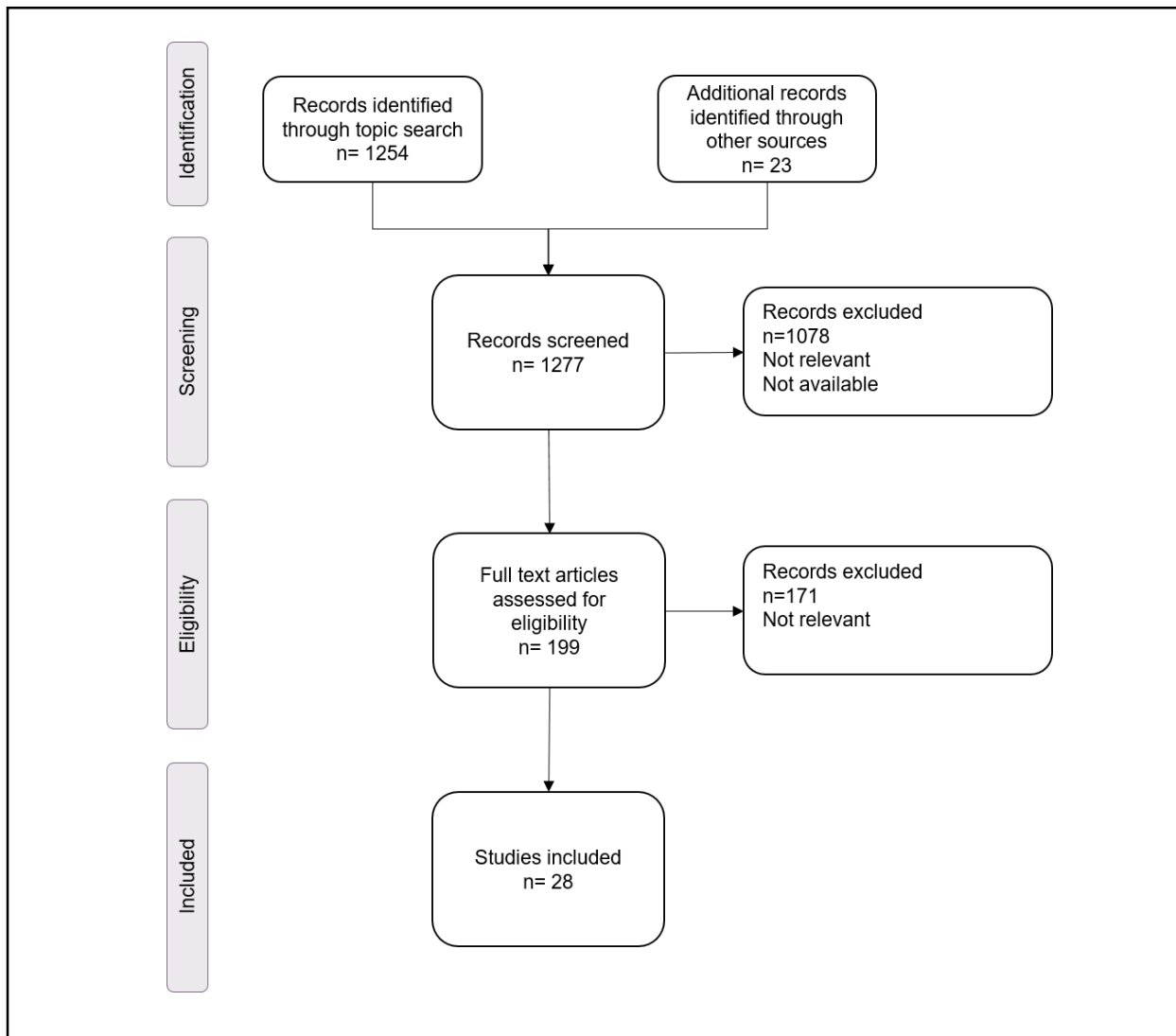
South Africa has a significant mobile phone penetration characterised by an intensification in the uptake of smartphones and mobile broadband. The existing mobile user base is increasingly sophisticated and many are already using mobile channels for accessing health-related services and information (Deloitte, 2016; Pew Research Center, 2015). These factors contribute to the

prediction of the Pew Research Center ( 2015) that South Africa is in an ideal position for the adaption and creation of innovative solutions and services for a local market. Such an opportunity could only be realised as part of a sustainable Digital Health Innovation Ecosystem (DHIE) that is adaptable, teachable and capable of reacting to changes and new challenges (Herselman *et al.*, 2016). As such, the nurturing and growth of resident competencies as credible localised mHealth innovation capabilities are essential.

This chapter aims to answer SRQ1: What constitutes mHealth innovation systems? Consequently, this chapter is structured to firstly, identify the elements that constitute *mHealth innovation*, and secondly, contextualise these identified elements to the components of an innovation ecosystem.

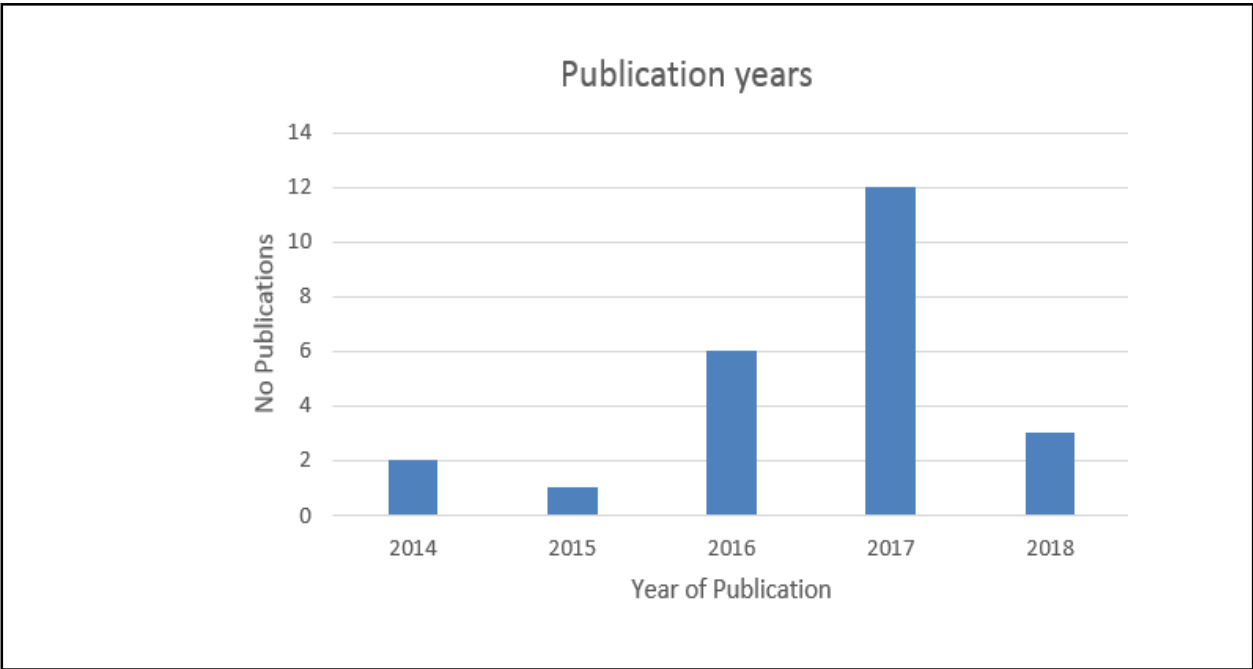
## **2.2 SCOPING REVIEW**

Scoping reviews are as a specific type of literature review regarded as a structured process to map key concepts within a body of knowledge (Arksey & O'Malley, 2005; Armstrong *et al.*, 2011). As outlined in Section 1.6.1, the main steps followed in this scoping review were that the researcher: i) searched selected curated academic lists; ii) selected relevant literature based on the SRQ 1; iii) pre-defined the inclusion criteria; iv) extracted data; and v) analysed, synthesised and reported results (Arksey & O'Malley, 2005). The following search terms were used: “mobile health innovation”; “mhealth innovation”; “mhealth”; “innovation”; “mobile health”; and “digital health innovation”. These searches presented 1,277 unique publications. A screening process was undertaken by applying the exclusion criteria. These criteria were medical innovations or interventions considered medically innovative rather than technology innovative; clinical studies; mobile health where mobility referred to being able to move as opposed to the portability of the device. Publications for which the full text could not be accessed, were also excluded. Through this screening process, 253 publications were identified for eligibility evaluation. Most of the publications removed in this iteration were obtained from PubMed.



**Figure 2-2: Article selection of the 1<sup>st</sup> scoping review**

Title and abstract evaluation for eligibility identified 28 publications that were accessible and were relevant. A summary of the publication years is presented in Figure 2-2.



**Figure 2-3: Publication years of articles used**

**2.3 RESULTS**

The articles were assessed to i) obtain an indication of how mHealth innovation and related innovation concepts are defined by authors; and ii) derive the components of an mHealth innovation system, based on constraints and challenges in mHealth as identified in literature. The results of these analyses are presented below.

**2.3.1 Conceptualising mHealth innovation**

The definitions of mHealth innovation (or innovation in the context of mHealth) were elicited from the selected literature. A limited subset of articles provided an explicit definition of innovation or mHealth innovation. Authors provided definitions that ranged from mHealth as an innovation that is focused on improvement and efficiency, for example Craig (2016), to mHealth innovation as the result of participation in an innovation ecosystem. These differing definitions are summarised in Table 2-1.

**Table 2-1: Conceptualising mHealth innovation**

PERSPECTIVES ON INNOVATION	DEFINITION	REFERENCE
Idea generation	Innovation – The ability to create new ideas	Iyawa <i>et al.</i> (2016)
Impactful	Innovation – an ‘innovation’ as a “new method, idea, product, etc.”, devised by one or more ‘experts’ which impacts on a given population when adopted by some members of that population.	Huang <i>et al.</i> (2017)

Facilitates improvement	Delivery innovation – any new product, service, or redesign of care that moves health systems towards the "triple aim" of improved patient experience, improved healthcare quality, and reduced costs.	Ostrovsky and Barnett (2014)
	The use of mobile phones to improve health.	Villalonga <i>et al.</i> (2016)
	Something that reduces the drudgery of time-consuming tasks, improves the effectiveness of existing methods or does something that was previously not possible.	Craig (2016)
	Emerging innovation that capitalises on features and ubiquity of mobile phones across the globe to facilitate communication between patients and health institutions to deliver health services and to promote health preventative behaviours.	Baulch <i>et al.</i> (2018)
Is part of an ecosystem	The concept of digital health innovation ecosystems also includes providing digital health services through the use of digital health technologies while incorporating the elements of innovation in a digital ecosystem platform where participants of the digital health innovation ecosystem remain connected. These technologies include mHealth, e-health, telemedicine, health 2.0/medicine 2.0 and health and wellness app.	Iyawa <i>et al.</i> (2017)

This broad range of descriptions was reflected in the focus areas of the articles under consideration. The articles ranged from discussions of a single mHealth application (for example, Gerds *et al.* (2014); Park (2016), to the conceptual consideration of digital health systems as complex adaptive systems (Paina & Peters, 2011) or knowledge economies (Bloom *et al.*, 2017), with mHealth applications as the result of the way in which such complex systems function and are influenced.

### 2.3.2 Elements of mHealth innovation

Subsequently the literature was reviewed with the aim of answering the SRQ 1: What components constitute an mHealth innovation system? To this end, the literature was read from the perspective of identifying elements of an innovation ecosystem that would enhance mHealth innovation. This was done by identifying barriers and challenges to mHealth innovations (within the broad definitions and interpretations outlined in the literature), defining the implications of these barriers and challenges for mHealth innovation, and translating the implications into elements that should form part of an innovation ecosystem (see Figure 2-3).



**Figure 2-4 Derivation of mHealth innovation elements**

The results of this process are summarised in Tables 2-2 to 2-4, where the information is organised according to identified innovation system components for macro, meso, and micro-level considerations.

**Table 2-2: Macro-level considerations in mHealth innovation ecosystems**

REQUIREMENTS, BARRIERS AND CHALLENGES	REFERENCES	REQUIRED ELEMENTS OF MHEALTH INNOVATION
New types of organisations, with players (including NGOs) as components of an integrated system	(Bloom <i>et al.</i> , 2017; Huang <i>et al.</i> , 2017)	Institutional players
New types of partnerships and networks across disciplinary boundaries (health, knowledge, and communications sectors); slow to create; complex arrangements (regulatory, politics)	(Bloom <i>et al.</i> , 2017; Peter <i>et al.</i> , 2018)	Institutional interactions
Government: active engagement in innovation, risk assessment and mitigation); buy-in to- and leadership of large interventions	(Bloom <i>et al.</i> , 2017; Lennon <i>et al.</i> , 2017; Peter <i>et al.</i> , 2018)	Government
Strategic academic-industry collaboration; Public-private partnerships	(DePasse <i>et al.</i> , 2014; Hill <i>et al.</i> , 2017; Pillay & Motsoaledi, 2018)	Partnerships
Formal and informal arrangements for provision of medical advice and drugs	(Bloom <i>et al.</i> , 2017)	
Where and by whom	(Huang <i>et al.</i> , 2017)	Decision making
Culture of entrepreneurship; culture to absorb innovation; culture of long-term planning; support for acceleration of innovative ideas	(Lennon <i>et al.</i> , 2017; Ostrovsky & Barnett, 2014; Walsh & Rumsfeld, 2017)	Institutional culture
Increased access to mobile technology creates new regulatory challenges	(Bloom <i>et al.</i> , 2017)	Regulation
Speed of technology exceeds speed of validation	(Park, 2016)	
Strengthen government's capacity as regulator	(Bloom <i>et al.</i> , 2017)	
Collaboration between policy makers, physicians, manufacturers, patients to ensure privacy of data and benefit to patients	(Daher <i>et al.</i> , 2017; Goldberg & Levy, 2016; Lennon <i>et al.</i> , 2017)	

REQUIREMENTS, BARRIERS AND CHALLENGES	REFERENCES	REQUIRED ELEMENTS OF MHEALTH INNOVATION
Ensure accuracy and correlation with real-world health outcomes; Lack of regulation hinders data quality and usefulness	(Erdmier <i>et al.</i> , 2016; Ranney, 2015),	
Safe and transparent use and assessment of digital health incentives; Clinical endorsement; appropriate evaluation and evidence of efficacy	(Hill <i>et al.</i> , 2017; Lennon <i>et al.</i> , 2017)	
Policies that enable innovation; incentives for alignment with health system objectives; national policy readiness	(Baulch <i>et al.</i> , 2018; Lennon <i>et al.</i> , 2017; Paina & Peters, 2011; Walsh & Rumsfeld, 2017)	Policy
Improved understanding between mHealth innovators and mainstream health system program and policy planners	(Bloom <i>et al.</i> , 2017)	

**Table 2-3: Meso-level considerations in mHealth innovation ecosystems**

REQUIREMENTS, BARRIERS AND CHALLENGES	REFERENCES	REQUIRED ELEMENTS OF MHEALTH INNOVATION
Open innovation	(Iyawa <i>et al.</i> , 2016; Iyawa <i>et al.</i> , 2017)	Innovation (nature)
Centralised vs. decentralised; formal vs. informal	(Huang <i>et al.</i> , 2017)	
Innovations to impact health outcomes across a spectrum from access to service delivery	(Daher <i>et al.</i> , 2017)	
Focused research programmes	(DePasse <i>et al.</i> , 2014)	Research
Investment in innovations that address specific health challenges, but also strategic investments in establishment of partnerships and networks with the capacity for innovation at scale	(Bloom <i>et al.</i> , 2017)	Investment
Specific funding platforms	(DePasse <i>et al.</i> , 2014)	Funding and business models
Novel, innovative business and revenue models	(Fernandez & Pallis, 2014)	
Funding model (combined public funding and out-of-pocket) to be matched with intervention	(Bloom <i>et al.</i> , 2017)	
Understand costs and benefits	(Huang <i>et al.</i> , 2017)	
Sustained donor funding; financial health; long-term commitment and funding for ongoing functions and innovation	(Peter <i>et al.</i> , 2018; Pillay & Motsoaledi, 2018)	
Market coherence; Understanding of market and appropriate selection of target customers	(Fernandez & Pallis, 2014; Lennon <i>et al.</i> , 2017)	

REQUIREMENTS, BARRIERS AND CHALLENGES	REFERENCES	REQUIRED ELEMENTS OF MHEALTH INNOVATION
Slow funding cycle in research environments	(Hill <i>et al.</i> , 2017)	
Open architectures as innovation infrastructure	(Baulch <i>et al.</i> , 2018)	Technology
National infrastructure readiness	(Lennon <i>et al.</i> , 2017)	
Wireless networks, 5 <sup>th</sup> generation communications networks, medical body area networks	(Fernandez & Pallis, 2014)	
Personal health device communications standards	(Fernandez & Pallis, 2014)	
Big data analytics should allow data storing, reporting, analysis visualisation, monitoring, prediction, decision making for continuous improvement	(Fernandez & Pallis, 2014)	
Difficulty in sharing data with healthcare providers, not easy to interpret	(Ranney, 2015)	

**Table 2-4: Micro-level considerations in mHealth innovation ecosystems**

REQUIREMENTS, BARRIERS AND CHALLENGES	REFERENCES	REQUIRED ELEMENTS OF MHEALTH INNOVATION
Portfolio of applications that have touch-points with the health system to alleviate constraints	(Labrique <i>et al.</i> , 2013)	Solution requirements need to be translated
Maintain focus on needs of the health system rather than technology; technology does not transform care	(Labrique <i>et al.</i> , 2013; Walsh & Rumsfeld, 2017)	
Ease of integration, interoperability, mechanisms for formal integration into system, incentivise, healthcare system structures for absorption of innovation	(Baulch <i>et al.</i> , 2018; Daher <i>et al.</i> , 2017; Labrique <i>et al.</i> , 2013; Lennon <i>et al.</i> , 2017; Paina & Peters, 2011; Peter <i>et al.</i> , 2018; Pillay & Motsoaledi, 2018; Walsh & Rumsfeld, 2017)	
Context-sensitive applications; application context and physical environment determines properties of selected technology; context and user engagement	(Baulch <i>et al.</i> , 2018; Daher <i>et al.</i> , 2017; Fernandez & Pallis, 2014; Paina & Peters, 2011; Peter <i>et al.</i> , 2018; Pillay & Motsoaledi, 2018)	
Value, usability, fit with workflow	(Wallis <i>et al.</i> 2017)	
Appropriate content	(Peter <i>et al.</i> , 2018)	
Evaluate entire set of possible solutions to determine optimal ones, within constraints and priorities of application	(Fernandez & Pallis, 2014)	Solution design approaches though domain translator
Collaborative planning and design; close collaboration between end-users, service users, application domain experts,	(Fernandez & Pallis, 2014; Hill <i>et al.</i> , 2017; Kato, 2017; Lennon <i>et al.</i> , 2017)	

REQUIREMENTS, BARRIERS AND CHALLENGES	REFERENCES	REQUIRED ELEMENTS OF MHEALTH INNOVATION
hardware designers, software developers, market specialists, road mapping strategists, academics		
Design for scalability; flexible and scalable; readiness to scale	(Daher <i>et al.</i> , 2017; Fernandez & Pallis, 2014; Hill <i>et al.</i> , 2017; Lennon <i>et al.</i> , 2017)	
Identify points of failure throughout process	(Peter <i>et al.</i> , 2018)	
Guidelines for implementation	(Iyawa <i>et al.</i> , 2016; Iyawa <i>et al.</i> , 2017)	Implementation approaches
Trajectories of problems and solutions	(Huang <i>et al.</i> , 2017)	
Roadmap: seamless introduction into routines, tech support, added value	(Wallis <i>et al.</i> , 2017)	
Advice to users with respect to safety; protect against counterfeit information; consumer education; access to technology and literacy; trust in technology; perceptions; access for different languages, people with impairments	(Gerdtts <i>et al.</i> , 2014; Goldberg & Levy, 2016; Lennon <i>et al.</i> , 2017)	Facilitation of Use
Communication and dissemination of innovation	(Hill <i>et al.</i> , 2017)	Dissemination
Measurement of innovation	(Villalonga <i>et al.</i> , 2016)	Monitoring and evaluation for continuous improvement
Ongoing evidence provision; evaluate from the outset, baseline data; adoption vs. acceptance	(Hill <i>et al.</i> , 2017; Huang <i>et al.</i> , 2017; Peter <i>et al.</i> , 2018)	
Monitoring and Evaluation essential	(Pillay & Motsoaledi, 2018)	
Process evaluation, proxy indicators of impact required	(Labrique <i>et al.</i> , 2013)	

Iyawa *et al.* (2017:1) proposed the following definition of a digital health innovation ecosystem: "[A] network of digital health communities consisting of interconnected, interrelated and interdependent digital health species, including healthcare stakeholders, healthcare institutions and digital healthcare devices situated in a digital health environment, who adopt the best-demonstrated practices that have been proven to be successful, and implementation of those practices through the use of information and communication technologies to monitor and improve the well-being and health of patients, to empower patients in the management of their health and that of their families."

Other relevant perspectives included that of a digital health system as a knowledge economy (Bloom *et al.*, 2017:1), which "allows us to circumvent the blind spots associated with donor-driven ICT-interventions and consider more broadly the forces that are driving e-health innovations."

Similarly, Paina and Peters (2011) proposes the formulation of digital health systems in terms of complex adaptive systems, which, in turn, considers a systems conceptualisation in which path dependence, feedback loops, emergent behaviours, and other elements are considered, thus focusing the attention to local contexts, incentives, and institutions; considering unintended consequences; and engaging actors for ongoing problem solving. The concepts, as identified through the analysis in Tables 2-2 to 2-4, are aligned with and support the systems perspectives of Iyawa *et al.* (2017), Bloom *et al.* (2017), and Paina and Peters (2011), as outlined here.

## **2.4 SUMMARY**

mHealth represents a rapidly growing field in digital health, with the potential to disrupt conventional healthcare delivery, enhance the quality of service delivery, and provide healthcare in previously unreached areas. However, numerous challenges impede the ability of the technology to deliver on its potential. Key constraints include the technology driven approaches to mHealth development, a lack of coordination among stakeholders, difficulty of integration with large national or regional healthcare information systems, and an inadequate regulatory environment to protect patients and ensure ethical and quality care.

Innovation ecosystems open up the possibility of providing an environment within which solutions can continuously be developed to deliver enhanced healthcare within a robust environment and to ensure a positive response to changing technological requirements as well as changing patient demands. This scoping literature review assessed different perspectives on, and implementations of mHealth. The selected articles addressed mHealth from perspectives that ranged from individual applications to reflections and novel perspectives on digital healthcare, such as the conceptualisation thereof as knowledge economy (Bloom *et al.*, 2017) or in terms of complex adaptive systems (Paina & Peters, 2011). These perspectives were integrated into the study finding to help distinguish the elements that are considered essential to an mHealth innovation system

The component-based approach (Wieczorek & Hekkert 2012) adopted for this study, styles an innovation system in terms of four elements, namely: i) actors; ii) soft and hard institutions; iii) interactions; and iv) physical financial, and knowledge infrastructure (Section 1.6.1). Towards answering the main research question, a synthesis of the literature overviewed in this chapter is presented in Table 2-4. The insights presented are framed by the adopted component-based approach.

**Table 2-5: Elements identified mapped to core structural components**

COMPONENT OF INNOVATION SYSTEM	MHEALTH INNOVATION SYSTEM ELEMENT (AS IDENTIFIED FROM SCOPING REVIEW)	REFERENCE
Innovations	Mobile innovations are characterised as supply-side driven and meet community (or sections of the community) needs.	(Baulch <i>et al.</i> , 2018; Daher <i>et al.</i> , 2017; Fernandez & Pallis, 2014; Hill <i>et al.</i> , 2017; Huang <i>et al.</i> , 2017; Iyawa <i>et al.</i> , 2016; Iyawa <i>et al.</i> , 2017; Labrique <i>et al.</i> , 2013; Lennon <i>et al.</i> , 2017; Paina & Peters, 2011; Wallis <i>et al.</i> , 2017; Walsh & Rumsfeld, 2017)
Actors and networks	The initiating actors in the South African mHealth innovation systems are established, large, located and formal. Domain experts translate needs and requirements to implementation. Macro level focus.	(Botha & Booie, 2016; DePasse <i>et al.</i> , 2014; Gerdtts <i>et al.</i> , 2014; Goldberg & Levy, 2016; Hill <i>et al.</i> , 2017; Huang <i>et al.</i> , 2017; Labrique <i>et al.</i> , 2013; Pillay & Motsoaledi, 2018; Ranney, 2015; Villalonga <i>et al.</i> , 2016)
Knowledge and learning	Learning by doing is operationalised as fail fast. Many pilots testify to this. Often non-sustainable innovations.	(DePasse <i>et al.</i> , 2014; Fernandez & Pallis, 2014; Hill <i>et al.</i> , 2017; Huang <i>et al.</i> , 2017; Labrique <i>et al.</i> , 2013; Peter <i>et al.</i> , 2018; Pillay & Motsoaledi, 2018; Villalonga <i>et al.</i> , 2016; Walsh & Rumsfeld, 2017)
Relations	Most relations are formal and based on contract terms.	(Bloom <i>et al.</i> , 2017; Daher <i>et al.</i> , 2017; DePasse <i>et al.</i> , 2014; Goldberg & Levy, 2016; Huang <i>et al.</i> , 2017; Lennon <i>et al.</i> , 2017; Peter <i>et al.</i> , 2018; Pillay & Motsoaledi, 2018)
Institutions	Mostly formal with contractual rules and regulations that guide actions. National regulation lacking much relevancy and tends to reflect a reactive engagement.	(Bloom <i>et al.</i> , 2017; Botha & Booie, 2016; Huang <i>et al.</i> , 2017; Lennon <i>et al.</i> , 2017; Park, 2016; Peter <i>et al.</i> , 2018)

These mHealth Innovation system components, matched to the elements (Table2-6), were further refined in the following chapter through a reflection of inclusive innovation.

# CHAPTER 3: INCLUSIVE mHEALTH INNOVATION

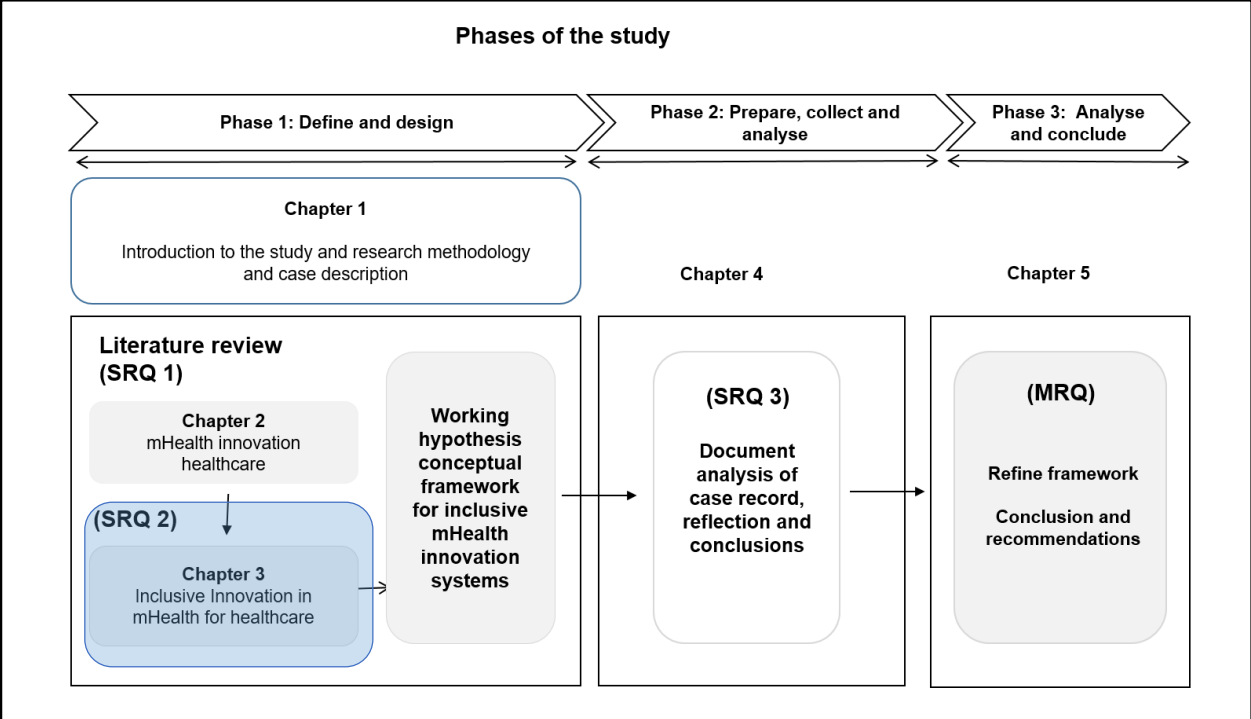


Figure 3-1: Phases of the study relevant to Chapter 3

## 3.1 INTRODUCTION

The intersection between poverty alleviation, innovation, and development has evolved. Diverse lenses have been applied to elucidate this intersection, such as Fu *et al.* (2011) exploration of the role of indigenous (or local) and foreign innovation efforts in technological change implicit to emerging economies catching up with developed economies. New terms such as, ‘reverse innovation’, ‘Bottom of the Pyramid innovation’, ‘frugal innovation’, ‘pro-poor vs. from-the-poor innovation’, ‘long tail innovation’, and, notably, ‘inclusive innovation’ have proliferated the field in abundance (Chataway *et al.*, 2014; Kolk *et al.*, 2014; Levidow & Papaioannou, 2018; Pansera & Owen, 2015). However, independent of the terminology used, enhancing innovation capacity is considered an important element of development and often advocates an inclusive approach (Heeks *et al.*, 2014) that some believe may provide profitable opportunities (London & Hart, 2010).

Kuhlmann and Rip (2015) suggest inclusive innovation systems development as a “grand societal experiment”, requiring i) a new arrangement of actors and interactions towards a diversity of options; ii) a new collection of participating institutions; iii) social innovation; iv) new capabilities, and; v) innovative ways to engage a greater variety of actors. Towards conceptualising these factors for an inclusive mHealth innovation framework in South Africa, this chapter presents an

exploration of the notion of inclusive innovation systems through a scoping review towards answering SRQ 2: What does inclusive innovation systems in mHealth entail?

### 3.2 SCOPING REVIEW

As outlined in Section 1.6.1, the main steps followed by the researcher in this scoping review were: i) searched selected curated academic lists; ii) selected relevant literature based on the SRQ 1; iii) pre-defined inclusion criteria; iv) extracted data; and v) analysed, synthesized and reported results (Arksey & O'Malley, 2005). The following search terms were used: “inclusive innovation”; “inclusive health innovation”; “inclusive digital health innovation”. These searches provided 169 unique publications.

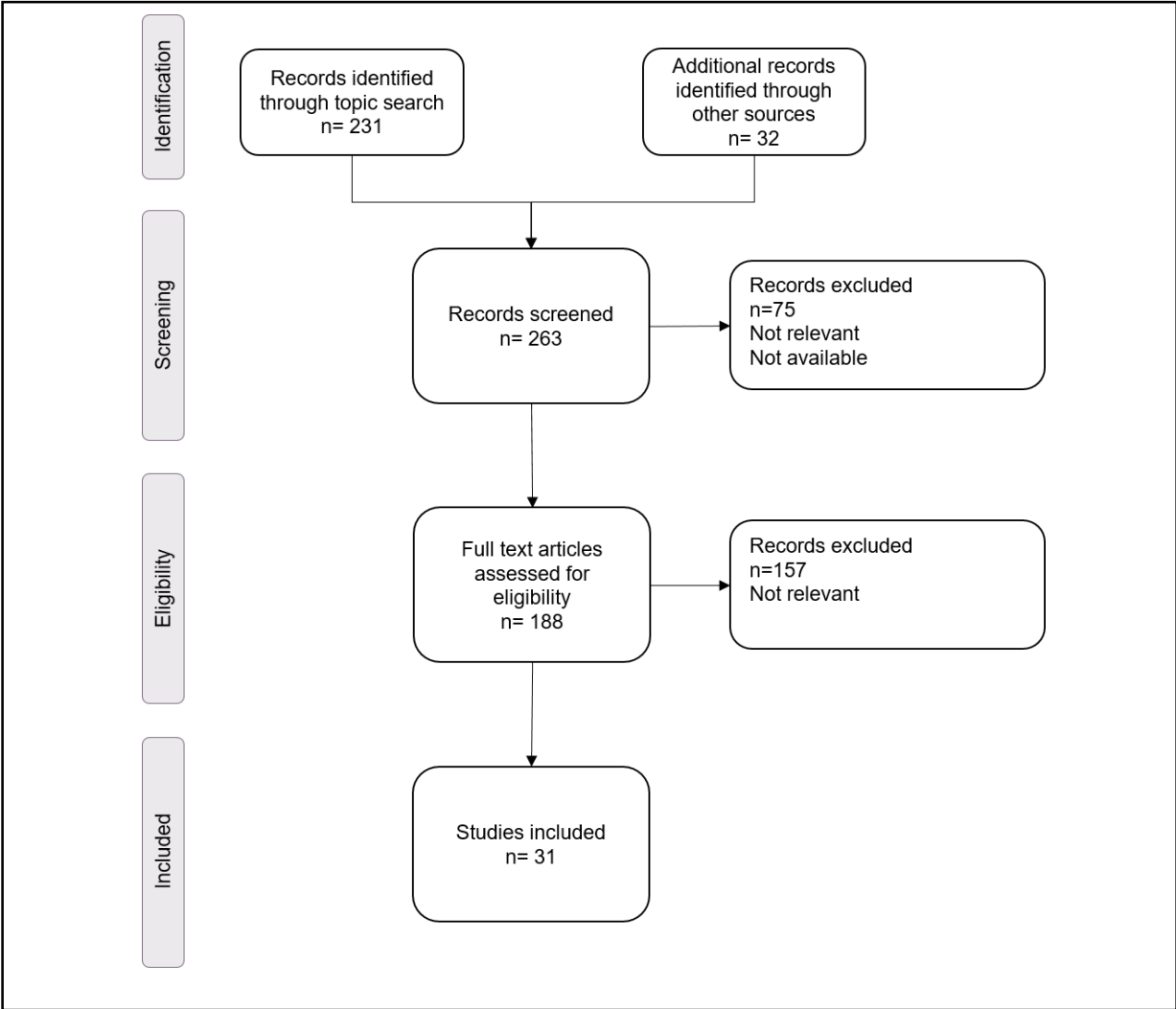


Figure 3-2: Article selection process for second scoping review

The publications were screened by applying the exclusion criteria. The exclusion criteria were clinical studies and medical innovations or interventions that were considered medically

innovative rather than technologically innovative. Publications of which the full text could not be accessed were also excluded. Through this screening process, 95 publications were identified for eligibility evaluation. A further evaluation of titles and abstract identified 31 publications for eligibility that could be accessed, and were relevant. A summary of the process is presented in Figure 3-1.

### 3.3 RESULTS

The results of the scoping review are presented in a structured narrative that, firstly, conceptualises the notion of inclusive innovation, and then expands on identified mobile innovation system components from Chapter 2.

#### 3.3.1 Conceptualising inclusive innovation

Bhatti and Ventresca (2013) argued that many concepts that have recently emerged describe innovations in emerging countries through a reverse innovation viewpoint or more specifically an inclusive innovation perspective (George *et al.*, 2012; Nijhof *et al.*, 2002). The inclusive innovation and other similar viewpoints all have a common theme of drawing on nuanced lessons from emerging economies. There are four aspects of inclusivity that are noted from literature (Altenburg, 2009; Cozzens & Sutz, 2012; Utz & Dahlman, 2007):

- Inclusivity of innovation precursors: concerns relevance of the innovation to a group;
- Inclusivity of innovation processes: addresses the inclusion in development;
- Inclusivity of innovation adoption: that a group have the capacity to consume the products; and
- Inclusivity of innovation: impact with regards to the innovation.

Foster and Heeks (2013) argued that any definition of inclusive innovation would require one or more of these four criteria to be met. The following definitions for inclusive innovation were noted from literature.

**Table 3-1: Defining inclusive innovation from literature**

DEFINITION FOR INCLUSIVE INNOVATION	AUTHOR
The development and implementation of new ideas which aspire to create opportunities that enhance social and economic well-being for disenfranchised members of society.	George <i>et al.</i> (2012:663)
The implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.	(OECD, 2005)
Something new with sustainable impact for and with the BoP.	(Anthony, 2012)
Structures and processes required to develop and deliver innovative technologies (goods and services) incorporating the needs and interests of the poor.	Foster and Heeks (2013:334)

DEFINITION FOR INCLUSIVE INNOVATION	AUTHOR
Both an outcome and a process, which has the end goal of improving the quality of life for the bottom of the pyramid, while simultaneously generating profit for involved multinational corporations.	(Awad, 2014)
Any innovation that leads to affordable access of quality goods and services creating livelihood opportunities for the excluded population, primarily at the base of the pyramid, and on a long-term sustainable basis with a significant outreach.	(Mashelkar, 2014)
Knowledge creation and absorption efforts that are most relevant to the needs of the poor.	(Dutz, 2007)

This study adapted the definition of George *et al.* (2012) to extend to entities currently excluded due to the quasi monopoly identified (Botha & Boo, 2016). Thus, *inclusive mHealth innovation* is defined as the development and implementation of new ideas, which aspire to create opportunities that enhance social and economic well-being of society.

The following section examines the identified literature through the five core components adopted and outlined in Section 1.6.1.

### 3.3.2 Core components of innovation systems

Five core components were identified as innovations: actors and networks; knowledge and learning; relations; and institutions. These were explored and described in the context of a mobile health innovation system in Chapter 2. Subsequently the nuances that inclusive innovation brings to each of the components are narrated.

#### 3.3.2.1 Innovation

Innovation is perceived as a key driver of economic growth in that it encourages increased industrial economic development through the development of products and services for consumers. While economic growth has been acknowledged as playing a significant role in poverty alleviation, a growing concern is that innovation can add to further disparity and exclusion (Foster & Heeks, 2013). As such, several alternative non-traditional innovation models are being touted as economically inclusive (Prahalad, 2010). Two types are prevalent. The first is characterised by products and services developed to benefit the excluded lower income market where the so-called *bottom of the pyramid* (BoP) are viewed as potential customers. Inherently this type of innovation seeks ways to reduce costs and produce a product or service that is affordable for this market segment. Kaplinsky and Morris (2000) referred to this as 'appropriate technology'. Additional terms found are 'frugal innovation', 'pro-poor innovation', and 'Bottom of the Pyramid innovation' (Cozzens & Sutz, 2012; Cozzens & Sutz, 2014).

A developmental approach is taken by the second type of innovation model found in literature. Examples include terms such as 'inclusive innovation', 'innovation for inclusive growth' and

'innovation for inclusive development' (George *et al.*, 2012; Paunov, 2013). Paunov (2013:4) describe the innovations as those that “*create or enhance opportunities to improve the well-being of those at the BoP.*” Here the bottom of the pyramid is viewed not only as a potential market but also as a co-creator in the innovation process. This co-creation process is expected to develop goods and services that can benefit the co-creators economically.

Cozzens and Sutz (2012) stated that inclusion has two dimensions that can be described in terms of the process by which it is achieved. As such, they argue inclusion is either passive or active. Passive inclusion denotes “reducing income inequality and bringing the poor out of poverty through raising their income”. In contrast, active inclusion is described as a liberating force that aims towards “giving rights, voice, capabilities and incentives for the excluded to become active participants in processes of development and innovation” (Johnson & Andersen, 2012). With regards to the latter and its co-creation focus, Ibrahim (2006:397) noted “*collective capability is not merely the sum of individual capabilities but rather capabilities that an individual would neither have nor be able to achieve if they did not join a collectivity.*”

Inclusive innovation is thus characterised by an incremental co-created innovation that should meet the local needs. As such, the process and the product are demand-driven.

**3.3.2.2 Actors and networks**

As outlined in Section 1.6.1, actors are the components that are involved in the innovation activities. These include: industry (firms); Higher Education Institutions and research institutions; government, and civil society (Foster & Heeks, 2013). This links closely to the quadruple helix of innovation and highlights the importance of the involvement of civil society in the innovation process (McAdam & Debackere, 2018).

As a participatory activity, inclusive innovation aims to actively include the community, either as a demographic entity or as domain entity. The ultimate objective is in empowering these communities to engender empowerment; being able to sustain and repeat development activities as the context changes (Kuruvilla *et al.*, 1994). Botha (2017:53) presents a typology of several categories of community participation these as outlined in Table 3-2.

**Table 3-2: Community participation (adapted from Botha, 2017:53)**

PARTICIPATION	DESCRIPTION
Passive participation	The community participates by being told what to do and/or what will happen.
Participation in information giving	The community participates by providing information during surveys, interviews or other extractive approaches.
Participation by consultation	The community is consulted and participates in this manner.

PARTICIPATION	DESCRIPTION
Participation for material incentives	The community provides resources such as labour in return for material incentives.
Functional participation	The community comes together to meet goals predetermined by the project.
Interactive participation	The community participates in shared analysis, planning and execution of projects.
Self-mobilisation	The community initiates its own interventions.

Four types of involvement for inclusive innovation initiatives were identified (Botha, 2017:55). These are presented and outlined in Table 3-3. The *Form* column describes the form of involvement; and the *top-down* column describes the interest in involvement from the initiators of the project. The *bottom-up* column is the interest in involvement from the community and the *Function* column is the overarching function of each type of involvement.

**Table 3-3: Interests in participation**

FORM	TOP-DOWN	BOTTOM-UP	FUNCTION
Nominal	Legitimation	Inclusion	Display
Instrumental	Efficiency	Cost	Means
Representative	Sustainability	Leverage	Voice
Transformative	Empowerment	Empowerment	Means/End

Botha (2017:55) further identifies and summarises some of the advantages for community participation in innovation activities. These are:

- Sustainability of the innovation in the sense that the community would be able to ensure its continuity;
- Efficiency as the co-creation and participation addresses community needs and so positions innovations for effective use of available resources;
- Self-reliance positions a community to become independent and autonomous; and
- Coverage provides a way to diffuse benefits attained throughout the community of participants and co-creators.

From the perspective of participating communities, actors and networks in an inclusive innovation activity are non-traditional and less formal demand-side innovators that are simultaneously co-creators and beneficiaries of the innovation or innovation process. Intermediaries act as translators of domain affordances and community needs in order to mitigate a possible mismatch between innovators, the domain and the local community needs.

### 3.3.2.3 Knowledge and learning

Malerba (2002) identifies the following types of knowledge that are inherent to an inclusive innovation system: hard knowledge as technical expertise; soft knowledge that relates to the functioning of the organisations that participate and their expected interaction; and awareness knowledge which is the degree of stakeholder awareness of the innovation system. Knowledge and learning entails the activities related to the processes of knowledge development and learning.

Foster and Heeks (2013) argued that innovation emerges from learning. This includes learning by doing (Hekkert *et al.*, 2007), learning by using, and learning by interacting. Kraemer-Mbula and Wamae (2010) noted in this regard that learning by interacting is considered central to serving certain markets. Learning about diffusion and use of the innovation and the wider processes that are at play is paramount to understanding and enabling innovation (Foster & Heeks, 2013).

### 3.3.2.4 Relations

Innovation systems provide a way to describe the interactions of the actors within the system and how the system changes as innovation is introduced. George *et al.* (2012) made a case for introducing different forms of partnerships and networks in aid of linking previously excluded communities to innovation opportunities. The study of Kruss and Gastrow (2015:20-22) on the relationship between South African universities and marginalised communities, identified four different complex relationship pattern groupings:

- socially responsive, research and teaching oriented pattern;
- teaching-oriented community and research-oriented industry (firm) interaction pattern;
- development-oriented service pattern; and
- industry, user, teaching and research orientated pattern.

Kruss and Gastrow (2015) provide a comprehensive summary of several ways in which partnerships serve as contributing enablers to inclusive development. These include funding, strategic leadership, equipment, facilities, and expert advice. Table 3-4 presents the synthesis of the approaches of Botha (2017), Grobbelaar *et al.* (2017) and Van der Hilst (2012).

**Table 3-4: Relation synthesis [adapted from Botha (2017), Grobbelaar *et al.* (2017), Van der Hilst (2012)]**

COMPONENT	DESCRIPTION
Relations	Informal, loose and socialised relations and partnership engagement.
Characteristics	<ul style="list-style-type: none"><li>• Formal or informal nature of relationships</li><li>• Collaborative networks and partnerships.</li></ul>

COMPONENT	DESCRIPTION
	<ul style="list-style-type: none"> <li>• Partner contributions such as funding, strategic leadership, equipment, facilities, expert advice.</li> <li>• Mode of community interaction e.g. cooperatives.</li> </ul>

The following section outlines institutions.

### 3.3.2.5 Institutions

North (1994) and later Woolthuis *et al.* (2005) described institutions as the explicitly articulated and/or spontaneously developed routines, culture, norms and regulations. Additionally, institutions, formal as well as informal, hold sway over individual actors and the system as a whole. Formal institutions, otherwise known as hard institutions, are the rules and regulations of an acknowledged authority. Informal institutions, also known as soft institutions, are considered implicit and organically co-created through actor interactions. As institutions tend to be sector specific, they differ significantly from one institution to another. Institution characteristics are outline in Table 3-5.

**Table 3-5: Institution synthesis [adapted from Botha (2017), Grobbelaar *et al.* (2017), Van der Hilst (2012)]**

COMPONENT	DESCRIPTION
Institutions	Institutions are a complex mixture of formal and informal institutions. Formal institutions have an indirect impact. Informal institutions play a significant role at a local level
Characteristics	Institutional policy will govern the inclusive innovation initiatives of Higher Education Institutions and other research institutions. Other external support systems contribute. Intellectual property and models of ownership need to be flexible to suit the context.

## 3.4 SUMMARY

This chapter overviewed the notion of inclusive innovation within the context of an innovation system. The five core components, namely innovations; actors and networks; knowledge and learning; relations; and institutions were explored and described from the context of a mobile health innovation system in Chapter 2. Subsequently the nuances that inclusive innovation brings to each of the components were outlined in this chapter. These are presented in Table 3-6.

**Table 3-6: Towards an inclusive mobile innovation system**

Component of innovation system	Mobile innovation system element (Chapter 2)	Inclusive innovation system element (Chapter 3)	Reference
Innovations	Mobile innovations are characterised as supply-side driven and meet the needs of the community (or sections of the community)	Inclusive innovation systems cater for alternative views of what consumer needs are and how they can be met.	(Cozzens & Sutz, 2012; Cozzens & Sutz, 2014; Foster & Heeks, 2013; George <i>et al.</i> , 2012; Johnson & Andersen, 2012; Kaplinsky & Morris, 2000; Paunov, 2013; Prahalad, 2010)
Actors and networks	Initiating actors in the South African mHealth Innovation systems are established, large, localised and formal. Domain experts translate needs and requirements to implementation. Macro level focus.	Inclusive innovation systems place a greater emphasis on alternative demand-side innovators. Bridgers and connectors match demand-side need with technology affordances.	(Botha, 2017; Craig, 2016; Foster & Heeks, 2013; Kuruvilla <i>et al.</i> , 1994)
Knowledge and learning	Learning by doing is operationalised as fail fast. Many pilots testify to this. Often non-sustainable innovations.	Opportunities to learn needs to be purposefully planned.	(Foster & Heeks, 2013; Hekkert <i>et al.</i> , 2007; Malerba, 2002)
Relations	Most relations are formal and based on contract terms.	Inclusive innovation relations are characterised by an informal and flexible social structure.	(Botha, 2017; George <i>et al.</i> , 2012; Grobbelaar <i>et al.</i> , 2017; Kruss & Gastrow, 2015; Van der Hilst, 2012)
Institutions	Mostly formal with contractual rules and regulations that guide actions. National regulation lack much relevancy and tend to reflect a reactive engagement.	Navigation between formal and informal	(Botha, 2016; Grobbelaar <i>et al.</i> , 2017; North, 1994; Van der Hilst, 2012; Woolthuis <i>et al.</i> , 2005)

Having identified and described inclusive innovation system elements (Chapter 3) and mobile innovation system elements (Chapter 2), Table 3-7 presents working hypotheses as a conceptual framework for the document analysis in the case study in Chapter 4.

**Table 3-7: Working hypotheses conceptual framework**

<b>Component of innovation system</b>	<b>Mobile innovation system element (Chapter 2)</b>	<b>Inclusive innovation system element (Chapter 3)</b>	<b>Working hypothesis (WH)</b>
Innovations	Mobile innovations are characterised as supply-side driven and meet the needs of the community (or sections of the community).	Inclusive innovation system cater for alternative views of what consumer needs are and how they can be met.	<i>WH 1: Inclusive mHealth innovation systems negotiate consumer wants and supply-side needs with regards to healthcare.</i>
Actors and networks	Initiating actors in the South African mHealth Innovation systems are established, large, located and formal. Domain experts translate needs and requirements to implementation. Macro level focus.	Inclusive innovation systems place a greater emphasis on alternative demand-side innovators.  Bridgers and connectors match demand-side needs with technology affordances.	<i>WH 2a: Alternative non-traditional innovators are included.</i>  <i>WH2b: Bridgers and connectors are incorporated early on in the innovation process.</i>
Knowledge and learning	Learning by doing is operationalised as fail fast. Many pilots testify to this. Often non-sustainable innovations.	Opportunities to learn need to be purposefully planned.	<i>WH 3: Purposefully structured domain-relevant learning is planned and operationalised.</i>
Relations	Most relations are formal and based on contract terms.	Inclusive innovation relations are characterised by an informal and flexible social structure.	<i>WH 4: Structured as well as informal relations are accommodated.</i>
Institutions	Mostly formal with contractual rules and regulations that guide actions. National regulation lacks much relevancy and tends to reflect a reactive engagement.	Navigation between formal and informal	<i>WH 5a: Structures are developed to facilitate relations that are, on the one side organic and flexible, and on the other formal and contracted.</i>  <i>WH 5b: Those responsible for operationalising inclusive innovation initiatives are able to feed into strategy formulation.</i>

**Table 3-8: Conceptual framework table**

COMPONENT OF INNOVATION SYSTEM	WORKING HYPOTHESIS (WH)	LITERATURE
Innovations	<i>WH 1: Inclusive mHealth innovation systems negotiate consumer wants and supply-side needs with regards to healthcare.</i>	(Baulch <i>et al.</i> , 2018; Cozzens & Sutz, 2012; Cozzens & Sutz, 2014; Daher <i>et al.</i> , 2017; Fernandez & Pallis, 2014; Foster & Heeks, 2013; George <i>et al.</i> , 2012; Hill <i>et al.</i> , 2017; Huang <i>et al.</i> , 2017; Iyawa <i>et al.</i> , 2016; Iyawa <i>et al.</i> , 2017; Johnson & Andersen, 2012; Kaplinsky & Morris, 2000; Labrique <i>et al.</i> , 2013; Lennon <i>et al.</i> , 2017; Paina & Peters, 2011; Paunov, 2013; Prahalad, 2010; Wallis <i>et al.</i> , 2017; Walsh & Rumsfeld, 2017)
Actors and networks	<i>WH 2a: Alternative non-traditional innovators are included.</i>  <i>WH2b: Bridgers and connectors are incorporated early on in the innovation process</i>	(Botha & Booi, 2016; Botha, 2017; Craig, 2016; DePasse <i>et al.</i> , 2014; Foster & Heeks, 2013; Gerdtts <i>et al.</i> , 2014; Goldberg & Levy, 2016; Hill <i>et al.</i> , 2017; Huang <i>et al.</i> , 2017; Kuruvilla <i>et al.</i> , 1994; Labrique <i>et al.</i> , 2013; Pillay & Motsoaledi, 2018; Ranney, 2015; Villalonga <i>et al.</i> , 2016)
Knowledge and learning	<i>WH 3: Purposefully structured domain-relevant learning is planned and operationalised.</i>	(DePasse <i>et al.</i> , 2014; Fernandez & Pallis, 2014; Foster & Heeks, 2013; Hekkert <i>et al.</i> , 2007; Hill <i>et al.</i> , 2017; Huang <i>et al.</i> , 2017; Labrique <i>et al.</i> , 2013; Malerba, 2002; Peter <i>et al.</i> , 2018; Pillay & Motsoaledi, 2018; Villalonga <i>et al.</i> , 2016; Walsh & Rumsfeld, 2017)
Relations	<i>WH 4: Structured as well as informal relations are accommodated.</i>	(Bloom <i>et al.</i> , 2017; Botha, 2017; Daher <i>et al.</i> , 2017; DePasse <i>et al.</i> , 2014; George <i>et al.</i> , 2012; Goldberg & Levy, 2016; Grobbelaar <i>et al.</i> , 2017; Huang <i>et al.</i> , 2017; Kruss & Gastrow, 2015; Lennon <i>et al.</i> , 2017; Peter <i>et al.</i> , 2018; Pillay & Motsoaledi, 2018; Van der Hilst, 2012)
Institutions	<i>WH 5a: Structures are developed to facilitate relations that are, on the one side organic and flexible, and on the other formal and contracted.</i>  <i>WH 5b: Those responsible for operationalising inclusive innovation initiatives are able to feed into strategy formulation.</i>	(Bloom <i>et al.</i> , 2017; Botha, 2016; Botha & Booi, 2016; Grobbelaar <i>et al.</i> , 2017; Huang <i>et al.</i> , 2017; Lennon <i>et al.</i> , 2017; North, 1994; Park, 2016; Peter <i>et al.</i> , 2018; Van der Hilst, 2012; Woolthuis <i>et al.</i> , 2005)

Chapter 4 outlines the case study and the document analysis towards evaluation of the seven working hypotheses presented in Table 3-8.

# CHAPTER 4: CASE STUDY

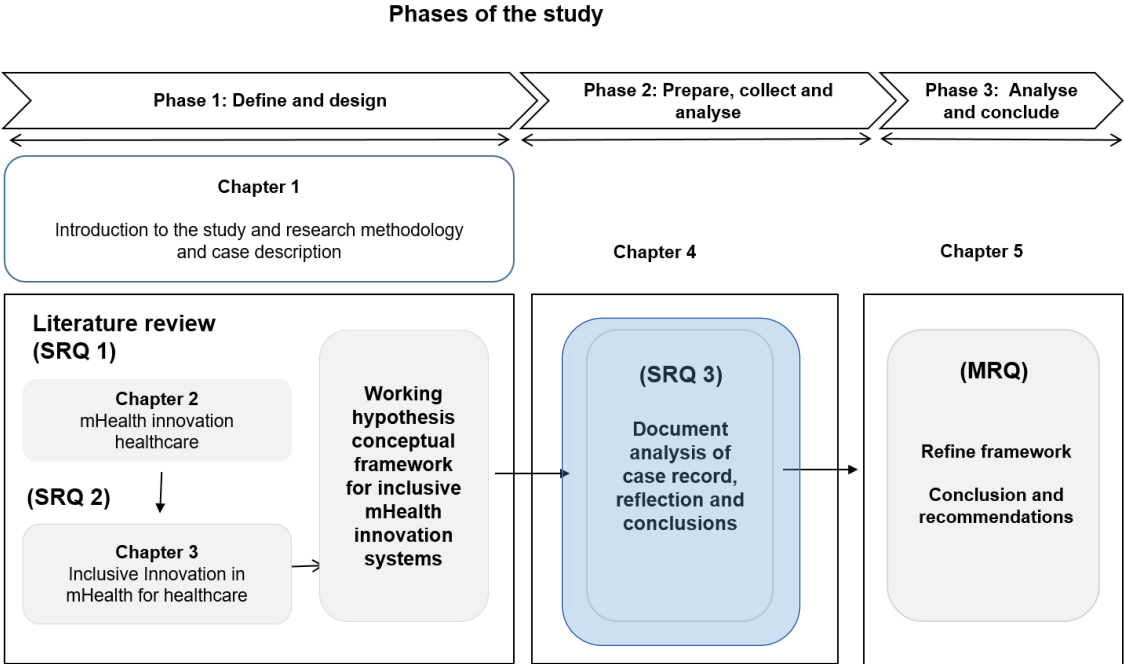


Figure 4-1: Phases of the study relevant to Chapter 4

## 4.1 INTRODUCTION

Chapter 4 aims to answer the SRQ3: How can inclusive mHealth innovation be realised in South Africa? Towards this end, the core components identified in Chapter 2 on mHealth innovation systems and in Chapter 3 on inclusive mHealth innovation systems are presented in Section 2.4 and Section 3.4. The subsequent working hypotheses conceptual framework (Sections 3.4, Table 3-7) frames the document analysis detailed in this chapter.

Bowen (2009:1) described document analysis as a “systematic procedure for reviewing or evaluating documents” that require data to be examined and interpreted to elicit meaning. The documents analysed (Section 1.6.2) in this study are in the public domain and were created over a two-year period during and after the *ReHealthAfrica* initiative. The use of documents as a stand-alone method in a qualitative study is not unprecedented (Angers & Machtmes, 2005; Wild *et al.*, 2010), but needs to be transparent and clear as to the selection of documents and the criteria used to analyse and reflect on them (Bowen, 2009).

To reiterate, the *reHealthAfrica* documents included using an all-inclusive sampling strategy, are again presented in Table 4-1. The documents are numbered for reference in this study and a brief description of each is included for clarity.

**Table 4-1: Documents utilised for analysis**

REFERENCE FOR THIS STUDY	DOCUMENT	BRIEF DESCRIPTION
Doc1	Presentation to stakeholder	Project summary for submission to the project manager at the CSIR.
Doc 2	Presentation to stakeholder	EU-GBS: eHealth Integration Platform: DST Steering committee presentation. 1 Dec. 2015.
Doc 3	DreamGirls Hackathon report	mLab Southern Africa in partnership with the CSIR hosted a DreamGirls International Outreach and Mentoring program in Cape Town. The theme of the workshop was "Health and Wellness." The purpose of the workshop was to educate teenage girls about Feminine Hygiene and Feminine Health towards the establishment of a learning ecosystem.
Doc 4	Codex Hackathon Report	The CSIR and mLab hosted an mHealth and Wellness hackathon at Workshop 17 in the V&A Waterfront in Cape Town. The purpose of the hackathon was to design and build innovative solutions in the mHealth and Wellness space.
Doc 5	Flyer	Flyer to promote the 2016 Cape Town mLab Demola mHealth Season powered by the CSIR Meraka Institute and Department of Science and Technology.
Doc 6	One 2017 project report;	Short summary and preamble for the innovation that would take place.
Doc 7	Published Conference paper	Contextualisation: An exercise in Knowledge Management and Transfer. A conference paper that was presented (Botha et al., 2017)
Doc 8	Published Conference paper	The value of co-creation through Design Science Research in developing a Digital Health Innovation Ecosystem for South Africa (Herselman & Botha, 2017).
Doc 9	One monitoring and evaluation report;	This report represents a review of the mHealth and Wellness ecosystem and innovation culture development programme within the EU-GBS Meraka programme and implemented during FY2016.
Doc 10	An interim project report from the <i>reHealthAfrica</i> team; and	mHealth and Wellness Innovation Ecosystem Component of the EU-GBS Major Highlights for 2015/16:
Doc 11	Book chapter. Chapter 8: mHealth & Wellness Innovation Ecosystem; in "Strategies, approaches and experiences towards building a SA building health innovation".	The purpose of the book is to provide an overview of how a Digital Health Innovation Ecosystem (DHIE) was developed based on different strategies, approaches and experiences over a period of time, and based on collaborations between the Council for Scientific and Industrial Research (CSIR) and VTT, known as the Technical Research Centre of Finland.

A comprehensive set of documents that are available in the public domain were used. A claim to legitimacy of the content and quality of the documents was made and sustained due to the inclusion of three academic peer-reviewed sources (Bowen, 2009). Working hypotheses are described by Shields and Tajalli (2006:320) as a provisional means to advance inquiry. The authors consider them as a statement of expectation that are not to be proven but either *supported* or *failed to be supported*. In this study, the scoping reviews led to the identification of elements of an inclusive innovation system (Table 3-6) towards further describing the components for an inclusive mHealth innovation framework for South Africa. To achieve the aim of this study, five working hypotheses were derived. Through this conceptual framework, data was collected using a document analysis and the hypotheses were evaluated. The description and assessment then contextualised the mHealth innovation for healthcare in the South African context and touched on some of the localised challenges and opportunities. Direct quotations from documents are referenced with the specific document and, where appropriate, the text is presented in italics. It should be noted that some of the verbatim extracts may contain grammatical errors, which has been retained to protect the integrity of the content.

The rest of this chapter details and describes the document analysis and presents summative reflections on each of the hypotheses towards the conclusion that is outlined in Chapter 5.

## 4.2 INNOVATIONS

**WH 1:** Inclusive mHealth innovation systems negotiate consumer wants and supply-side needs with regards to healthcare.

- *Doc1: Innovation is only as strong as the ecosystem in which it is created.*

This study highlights the willingness of various industry partners in and around the healthcare domain to participate in innovation ecosystem activities.

- Doc11: While they all showed interest in perusing mHealth challenges, the first season results trended towards industry-specific solutions.
- *Doc11: These initial partners have indicated their interest in participating again and with some mHealth & Wellness Challenges now that they understand the open innovation and co-creation process better.*
- *Doc10: Knowledge transfer aimed at upskilling stakeholders on issues pertinent to the innovation and mHealth and Wellness space.*

Not only is there a willingness to participate in local innovation, but also a sense of responsibility to collaborate and participate.

- *Doc8: An innovation ecosystem should be based on the common interest of all actors in a quadruple helix.*
- *Doc8: ...based on the common interest of all actors in a quadruple helix.*

The outcome of such participation and collaboration stimulates not only individual, but also communal interests.

- *Doc8: The outcome of the application of co-creation where different stakeholders were involved resulted in the development of a Digital Health Innovation Ecosystem for South Africa.*
- *Doc3: The hackathon participants were encouraged to design solutions to enhance wellness in South Africa, but more specifically in their communities.*
- *Doc3: An ideation process followed after the challenge was defined and presented by the CSIR.*

The idea around inclusive innovation is emphasised to avoid substandard versions of innovations to communities by having communities participate in the design, affordability and the development process towards relevance. The tailoring of services to meet the needs of communities is paramount to ensure widespread acceptability in target communities.

- *Doc5: ...promoting and developing efficient co-creation methods.*

The co-creation efforts start on an unequal footing. As such not all traditional methods of co-creation are considered effective. The willingness to listen and learn from local communities plays a significant role in engaging them early on in the process.

- *Doc 7: The removal of power distance: Viewed as a key enabler to true co-creation the programme and processes involved the elimination of any power distance between the industry partner representative and the student teams.*
- *Doc 5: Connecting higher education (HE), industry and innovation.*

A co-learning approach is not considered endemic to higher education and industry. The process of innovation needs to facilitate interactive learning opportunities that would 1) enable communities to express and share their experiences and 2) industry to interpret and adapt the experiences to services or products. Higher Education played a pivotal role to form the coalface of engagement.

- *Doc 5: Through the mLab-Demola mHealth season we will collaborate to develop a concept that can lead to a prototype within a set time-frame.*

The industry outlook on the innovation process had to be mitigated as their expectation and time frame for specific innovation activities were not always seen as realistic. mLab assumed an intermediately role to facilitate and guide these negotiations guided by the Demola process.

- *Doc 6: It becomes imperative that the Stakeholders in general and specifically those that were identified as most active be made part of a consulting process to incorporate the already fragmented Mobile Implementation domain into the proposed South Africa Health Information System. This system will have to facilitate the functionalities and functions of existing Implementations to harness the learning done and gains made towards realising the South African EHealth strategy vision as "enabling a long and healthy life for all South Africans"*

mLab assumed not only the facilitation and mediation role, but provided a source of knowledge that the innovators from the communities were lacking. Domain knowledge and an understanding of the gaps in the market, available technologies, and trends were valuable contributions to the innovation initiative. The specific skills of students and their understanding of their own communities were tacit intellectual property that the students themselves did not initially necessary value.

- *Doc 7: Students do not always value their own knowledge domain until they work together in multidisciplinary teams and brainstorm with each other on ideas to build their product. This allows for a sandbox approach within a safe place, where student get the freedom to explore all options. The student gains are experienced as more than just an innovative product; they also gain experience in working with industry, becoming more effective workers. They learn the value of thinking out of the box and to then apply their own knowledge domains to add value to group thinking.*

The value proposition of the industry partners was not necessary recognised as being fiscal in nature. Continuous and ongoing arbitration was needed, especially in instances where companies that had not previously participated were involved. Their understanding of the value of engagement was limited as the local industries were more sales focussed that research and innovation.

- *Doc 10: ...offer participating industry partners a number of benefits such as a cost-effective external validation of internally generated innovation, mutually beneficial collaboration with participating Higher Education Institutions and Innovation Spaces, a better visibility in local, regional and international Innovation Ecosystems and a pipeline for recruitment.*

- *Doc 10: Ecovation is the result of an ecosystem where various stakeholders can co-create new innovations within their own contexts.*

A themed mHealth and wellness innovation focus contributed to the unlocking and exploitation of an under-resourced and fertile innovation space.

- *Doc 10: These users were facilitated in the mHealth & Wellness innovation season through specific challenges that were posed and would focus on selected users relevant to the challenge.*

#### **4.2.1 Summary of work hypothesis 1**

- *There is sufficient evidence to argue that work hypothesis 1 is supported.*

Further nuanced insights are that a negotiation process in inclusive innovation is a purposeful activity that, on the one hand extends to industry, and on the other hand needs to reach out to communities. The need to up status, often tacit knowledge that individuals do not always value, is essential, as it is invaluable in the community understanding that needs to be facilitated. The negotiation outcome practices are not endemic to industry, higher education institutions, or communities and are considered a compromise towards a common innovation goal achievement. Consequently, the notion of 'innovation' as an event is unsuitable and an incremental process through a continuous loop of information sharing is a more apt conceptual understanding.

### **4.3 ACTORS AND NETWORKS**

**WH 2a:** Alternative non-traditional innovators are included.

Community-based innovation activities rely on the active participation of entities that do not necessarily see themselves as innovators or understand their ideas and insights to be innovative. This necessitates a total rethink of what innovation in the health field looks like and acts like.

- *Doc 1: It is about re-engineering, re-thinking and reimagining Health Innovation in Africa.*

To include and bring these insights to the fore is an energy intensive process that does not take place or spread organically.

- *Doc 1: Demonstrate a systemic approach to innovation using adapted innovation techniques within the national system of innovation.*

Inclusive innovation involves a restructuring within the National System of Innovation to facilitate innovation techniques that allow for or structure the desired goals.

- *Doc 3: ...allowing students to design and build solutions to challenges in mHealth and Wellness.*
- *Doc 3: The students received valuable feedback on their applications, which could guide and assist them in improving on their applications and in future development.*
- *Doc 9: Link University students and other youth innovators to form multidisciplinary teams that will collaborate and co-create with industry.*

The process that was adopted created space for community participation through students at local higher education institutions to contribute and share through a facilitated process of innovation.

- *Doc 3: An ideation process followed after the challenge was defined and presented by the CSIR.*

The health domain challenges and scope were contextualised by third party stakeholders with a mandate to engage in- and grow the innovation system in South Africa. Alternative strategies and approaches were used towards broadening the value creation landscape beyond the traditional.

- *Doc 5: Changing the landscape of value-creation enablers.*
- *Doc 10: ...applied to a specific challenge that they were interested in.*

A single success approach was not considered appropriate; several innovation outcomes were anticipated and planned for in order to sustain the efforts of the non-traditional innovators and to try keep them in the innovation landscape beyond a potential lack of initial interest from the industry partner.

- *Doc 5: ...have the opportunity to licence or sell the IP to your prototype and you might even think of keeping your team intact to form a business partnership.*
- *Doc 7: Innovation mechanism would be used to catalyse and stimulate an ecosystem and facilitate youth involvement, industry co-creation, and network formation.*
- *Doc 8: ...different stakeholders were involved [and] resulted in the development of a Digital Health Innovation Ecosystem for South Africa.*

Best practice from international experiences were not always considered relevant to the local domain and the development of solutions though the innovation process had to be adapted to the local needs of the innovators.

- *Doc 9: These mobile solutions are being developed through utilising elements of the Demola lean innovation methodologies and represent a localised adaptation of applying this within real project development environments and with smaller teams consisting of technically skilled youth and product owners.*

The multidisciplinary teams within the university setting contributed to various opportunities as a purposeful mix of views and experiences were facilitated.

- *Doc 10: Formation of multidisciplinary teams that will collaborate and co-create with industry...Co-creation endeavours with industry collaborates around mHealth innovation challenges.*

#### **4.3.1 Summary work hypothesis 2a**

- *There is sufficient evidence to argue that work hypothesis 2a is supported.*

Additional insights are that the process as well as the structures that enable these innovators to participate are staggered and multi-tiered in nature towards engaging and keeping and supporting them in the current system of innovation.

**WH 2b:** *Bridgers and connectors are incorporated early on in the innovation process.*

Understanding and enabling innovation activities and needs are identified as crucial. The domain knowledge and insights are not necessary endemic to novice non-traditional innovators. As such, as part of a negotiation process, these insights are translated and presented. Such a presentation needs to be experienced as unbiased and value-laden to benefit the collaborators in the innovation activities.

- *Doc 3: Critical components of a wellness mHealth application were provided to the participants in order to assist them in the development of their applications.*
- *Doc 3: CSIR presented a real-world problem, which was addressed by all of the applications developed by the CodeX students during the course of the hackathon.*

The collaborators' translation of the domain knowledge into issues that are relevant and real for them is critical.

- *Doc 5: ...be part of co-creating with industry to solve real-world problems.*

- *Doc 4: We believe that ground-breaking innovation is created only when people with passion and talent are interconnected across nations, cultures and fields of expertise.*

This localisation of the understanding of the health domain at a personal level enables customisation towards local relevance.

- *Doc 8: ...issues related to localisation and customisation of systems.*
- *Doc 5: Stimulating collaboration with mHealth stakeholders.*

Gaps that might be missed or not anticipated were identified and applied through the lenses of localised insights.

- *Doc 6: The MHealth Applications potentially show the gaps that have not adequately been explored.*
- *Doc 6: The strategic innovation opportunities within the mHealth and Wellness space, South Africa's large installed user base of Mobile Users and the dearth of South African innovations in this space, provides a fertile setting towards stimulating an mHealth and Wellness Innovation Ecosystem.*
- *Doc 9: Link with national and international industries to establish relevant future mHealth Challenges.*

These localised insights provide multiple opportunities for international and national brands and entities to unlock opportunities in the innovation space. New processes of innovation, business concepts and understanding of localisation were established, not only with industry but also within the actual innovation process that was adopted.

- *Doc 6: When we first embarked on this mission we engaged with a number of Health & Wellness brands within the local market to help identify possible challenges that could be worked on during the co-creation season it very quickly became evident that while they had many challenges, they grappled with understanding the role of and how technology, especially mobile and wearables, could solve them...With this in mind we challenged our young and talented Demola students during the first season to explore the latest technologies available, both within the health sector and commercially available to us all, and develop some possible innovations within the mHealth & Wellness space.*

### 4.3.2 Summary of work hypothesis 2b

- *There is sufficient evidence to argue that work hypothesis 2b is supported.*

Some insights that could extend the conceptualisation of the understanding of bridges and connectors are that the innovators themselves become part of the extended network within the sphere of connections. This steers towards future possibilities and connections that are to be made, even after the formalised innovation process has run its course. It seems to point to an unverified exponential increase in opportunities as the new innovator and innovation become part of a wider community of contacts.

## 4.4 KNOWLEDGE AND LEARNING

**WH 3:** *Purposefully structured domain relevant learning is planned and operationalised.*

Considering that knowledge is developed through the process of learning and is thus part of the innovation process, all participants and collaborators within an innovation activity will experience some sort of learning. The purposefully structured learning opportunities facilitated knowledge transfer from the project team that consisted of health domain experts, technical teams, higher education collaborators and, to a lesser extent, the industry partners.

- *Doc 2: DreamGirls motivates young women to study at a college or university by working with girls, aged 15 - 19 years, to help them set goals for the future and find the right path to achieving their goals.*
- *Doc 2: The purpose of the workshop was to educate teenage girls about Feminine Hygiene and Feminine Health.*

The knowledge diffusion extended to domain knowledge on specific health and wellness issues so that it included methodological structures for working and exposure to technologies that might have been unfamiliar to the workshop attendees.

- *Doc 3: The participants of the hackathon followed an agile methodology to plan, design and build solutions for the challenge.*
- *Doc 6: One of the best learnings were about the importance of user involvement in the innovation process and while playing with all the gadgets helped the real breakthroughs happen when speaking to Doctors and relevant users about the actual experiences.*

International exposure to diverse ways of doing and thinking were novel experiences. These international exposures contributed to the different sources of knowledge and the processes to gain that knowledge.

- *Doc 6: It added so much insight about the small but important things.*

Through the learning opportunities provided, international networks and exposure was facilitated to actors that had previously not had these opportunities.

- *Doc 5: Gain experience, international credit and exposure where opportunities abound.*

The Demola Innovation Model was purposefully selected and investigated because its own best practice activities had refined innovation to a structured activity that, in itself, pre-empted the innovation needs that would be experienced in the end. These needs, such as markets, licensing and industry relevance, were part of the co-creation with industry around useful and usable healthcare artefacts. Different types of knowledge were valuable to different stakeholders.

- *Doc 7: The DIM [Demola innovation model] process can be seen as an intentionally structured innovation methodology consisting of a number of guided interventions, the space where the activities take place and the management of the co-created IP and stakeholder interactions.*
- *Doc 7: [...] knowledge can be stored, embedded or represented in .... [the] Participant's knowledge, the culture, the infrastructure, their knowledge artefacts, the purpose and the DIM [Demola innovation model] strategy.*

The diverse knowledge transfer opportunities included opportunities for the students, the higher education institutions that become part of the innovation activities, the facilitating local entity, and local facilitators.

- *Doc 7: These learnings from many an academic viewpoint might be one of the greater gains for students, allowing them to upskill through a structured and facilitated industry interaction.*

Much of the infrastructure and knowledge gains would remain available for local innovators and facilitate further healthcare innovation efforts.

- *Doc 9: the creation of an open lab programme to make resources procured for the Demola programme available to SMME's and Innovators to utilize for their own research, development and commercialization purposes.*

The infrastructure was only one sustained contributing aspect of the innovation activities as future co-creation endeavours were anticipated and later realised.

- *Doc 9: Manage the co-creation endeavours with industry partners around mHealth innovation challenges.*

The localised process furthered these endeavours by assisting mechanisms that would further the innovation towards productisation and continuous education of the participants around market trends, technology availability and the domain needs.

- *Doc 9: Assist with licensing and deployment of solutions.*
- *Doc 10: Conducting research and development.*

#### **4.4.1 Summary work hypothesis 3**

- *There is sufficient evidence to argue that work hypothesis 3 is supported*

Different types of knowledge were transferred; the most prominent types being the technical “know-how” of the innovation and the technology that supports it. Technical knowledge empowers individuals, the innovation teams and the larger community. The larger community acts as co-creator, designer and, ultimately the healthcare innovation consumers. This type of knowledge is broadly categorised as technical and technological. Additionally, the narratives and explaining that underpinned the sharing of social and cultural context was evident from all of the participants. The community innovators, the Demola team and the local facilitators spent much time negotiating a common understanding of their individual needs and positions. The resulting trust and understanding lead to the formation of ongoing relationships beyond this single activity. The development of a *collaborative culture* was highly valued, especially by industry partners. The industry knowledge transfer was expedited by implicit business processes in the innovation model such as the creation of IP as opposed to the creation of a technology artefact, the licensing of the artefact and the negotiations with the industry, academia and the innovators themselves.

The last recognised knowledge type can be described as domain knowledge. In this instance, the CSIR conveyed the domain knowledge that included prominent domain needs, opportunities and trends. This enabled the innovators to interpret and apply the opportunities to their own community’s needs.

## **4.5 RELATIONS**

**WH 4:** *Structured as well as informal relations are accommodated.*

Relationship structures extended to multiple simultaneous roles that were adopted by the individuals and organisations that were participating. The pre-existing relationships were *carried into* the inclusive innovation collaboration and were augmented with various other additional relations. The Demola innovation model promotes the view that these new relations should be created and maintained as flat as possible, trying to assure that individual voices and agency do not become overshadowed by the larger corporates or established structures.

- *Doc 2: Towards connecting Higher Education, Industry and Innovation.*
- *Doc 10: Initial interest for corporate partnership has been expressed by various multi-nationals such as INTEL, IBM, MTN, Microsoft and Ericsson.*
- *Doc 5: Innovation is based on a fusion of ideas, skills and perspectives.*
- *Doc 2: Towards stimulating interest amongst Higher Education students.*

The relations, where considered appropriate, were mitigated by mLab as the local implementation partner.

- *Doc 5: A sustainable university-industry collaboration that brings practice to theory and opens access to an international network and multiple opportunities.*

Where there were no existing relations, relations were mitigated and introduced.

- *Doc 5: ...promoting and developing efficient co-creation methods*

The insights that were obtained on the domain needs and opportunities, encouraged individuals to rethink and reposition their own and community relations with regard to healthcare and the understanding of what it is.

- *Doc 7: It is very much about moving away from the artisanal and analogue mode of organising and providing healthcare.*

The facilitated relations thus needed to facilitate formal structures as part of the more formal pre-existing and predefined relations needed to facilitate business functions (such as licensing and IP registration), but additionally needed to enable a more informal quality that would allow and encourage the sharing of ideas on an equal footing.

- *Doc 5: Innovation with true impact cannot be created in isolated and disconnected units.*
- *Doc 10: The interaction agreement is negotiated by the students and the industry partner, and it forms the basis of their future co-creation endeavours. The co-*

*creation activities that follow are part of a structured innovation process that is facilitated by the Demola Innovation model.*

#### **4.5.1 Summary work hypothesis 4**

- *There is sufficient evidence to argue that work hypothesis 4 is supported*

The nature of the pre-existing inclusive innovation relationships tended to be more formal and structured, such as the mandate of the CSIR, the mandate of the MLab, and others. The nature of the facilitated relationships were characterised by informal groups, cultural and community relationships. The extended collaborative networks and partnerships additionally provided the means for contributions to be made to the collective. These contributions were not only in the form of facilities, equipment, funding, skills or knowledge, but also included guidance, workplace exposure and recognition. Access to the community and their needs were noted as particularly relevant in ideation of innovative solutions for particular health related needs.

#### **4.6 INSTITUTIONS**

**WH 5a:** Structures are developed to facilitate relations that are, on the one side organic and flexible, and on the other formal and contracted.

It was noted that current institutions did not meet the need to facilitate co-operative knowledge development and to disseminate knowledge to side-lined members in order to enhance sustainable entrepreneurial activity at this level.

- *Doc 1: Youth empowerment in partnership with local and international industry through co-creation opportunities.*
- *Doc 5: It [innovation] requires novel ways to collaborate in an international network that brings together people and organisations from various fields.*
- *Doc 5: Enhancing innovation competences both on individual and organisational levels.*

Universities, in practice, find it difficult to collaborate with one another and cohabitation at one university held the risk of alienating the others. Centrally neutral structures were put in place to provide mechanisms for various higher education entities to collaborate.

- *Doc 7: Providing a central or accessible location between multiple universities in South Africa poses a unique challenge due to the location of the different universities.... The location also needs to cater for the industry partners, who by definition are largely positioned in the higher income segment of society.*

The contributions from industry held a significant validation function as this was an unknown variable for most of the students. It was noted that the structures additionally enabled industry to reach out and secure a talent pipeline that would extend beyond the innovation opportunities.

- *Doc 7: A significant part of the innovation process relies on continuous validation from within and from external customer or stakeholders. This process of validation ensures that all the stakeholders are up to date and comfortable with the direction of thought.*

The student innovators were presented with the opportunities and structures to translate their innovation artefacts into intellectual property that could become a completely sellable product idea.

- *Doc 10: ...the students retain full IP rights to their innovation and have the option to be absorbed within the next level of innovation support structures such as incubators and accelerators.*

#### **4.6.1 Summary work hypothesis 5a**

- *There is sufficient evidence to argue that work hypothesis 5a is supported.*

Structures were developed to facilitate relations. The relations were either informal, characterised as organic and flexible, or formal and contracted, depending on the function of the relations. The two layers of relationships allowed for community incorporation and equity when it came to negotiations around ideas, community needs and domain opportunities. In addition, the rigidity of business collaborating and the gravitas lent to the handling of issues related to the innovators IP, were facilitated by the establishment of more structured and bound relationships.

**WH 5b:** *Those responsible for operationalising inclusive innovation initiatives are able to feed into strategy formulation.*

It can be claimed that in the policy environment, there are many who aim to drive innovation on the one hand and inclusion on the other. The health domain is moulded around many policies that specifically aim to govern and direct activities. To enable a combined, specific governance to address inclusive innovation in healthcare is arguably a specific niche that is tentatively being explored and addressed.

- *Doc 1: The aim of this investment is to stimulating the South African innovation ecosystem for mHealth and uHealth (wellness) solutions.*
- *Doc 6: mLab South Africa with its existing mandate, experience and network.... towards the growth of the South African National System of Innovation (NSI).*
- *Doc 10: The strategic innovation opportunities within the mHealth & Wellness space, South Africa's large installed-user base of mobile users, and the dearth of South African innovations in this domain, provide a fertile setting towards stimulating a mHealth & Wellness Innovation Ecosystem.*

Beyond the single instantiation of an innovation ecosystem in healthcare, the lessons learnt and experiences gained would inform and guide similar interventions into Africa

- *Doc 7: The initial implementation in South Africa would serve to guide further enactments within the country and the rest of the African continent.*
- *Doc 7: Transferring the model from Finland to the South African and African context necessitates contextualisation. As this specific innovation model's localisation is framed within an initiative to facilitate co-creation between South African and international industry and academia, it becomes important to manage the knowledge transfer rather than leaving it to providence.*
- *Doc 9: Several proposals have been developed and submitted to DST [Department of Science and Technology] as part of bilateral programmes with Zambia and Tanzania which will see the lean innovation programmes and reHealthAfrica challenges expanding into Africa.*

The localisation and local understanding of the community healthcare needs and the opportunities that exist to address these from the larger domain solutions that have been deployed, allow for

unique contextualisation and localising that is eminently something that should happen with a community that it aims to serve.

- *Doc 7: As such, the change in the nature and understanding of local industry partners with respect to the IP will ultimately be the goal.*
- *Doc 7: ...should in addition allow for contextualisation and in a way form a co-creation between the implementing partners and the stakeholders in establishing a new instance.*

Ultimately, this ecosystem should fit into the South African National Innovation System in a sustainable way without further fragmenting opportunities to a few, but to unlock opportunities and the structures needed to participate in full.

- *Doc 10: Strengthening the South Africa's National Innovation System can only be realised once implementation takes place and lessons are learnt to develop best practices.*

#### **4.6.2 Summary work hypothesis 5b**

*There is sufficient evidence to argue that WH5b is supported.*

Various challenges exist at a policy level when aiming to facilitate and support community innovations. Noting that an innovation ecosystem acts as a complex collection of separate yet linked interactions, it is argued that single solutions are possibly not a viable option. Instead, highly adaptable approaches and best practice have a greater impact on practitioner-based interventions. Inclusive innovation is often a structured and intentional intervention. To have the desired effect on the larger system of innovation, the scale and dissemination of such an event needs to be strategic and supported by not only the facilitation, but also by policy. Arguments and motivations need to speak to several government stakeholders with many diverse sets of interest because public policy is usually the domain of the Government, and many layers of government needs to act in *concert* to deliver impactful policy.

#### **4.7 SUMMARY**

The component-based approach to describing innovation ecosystems was identified as the unit of analysis for the case study. These components were articulated as working hypotheses and presented in a working hypothesis conceptual framework (Table 3-7) in accordance with Yin (2008) who argued that theory development is essential prior to data collection when doing a case study. This view is collaborated by Gregor (2006) who described theory as a tool, stating that theory “provide[s] explanations and predictions and [needs to be] testable”. The working

hypothesis conceptual framework statements were used in the document analysis of the generated documents of the *reHealthAfrica* initiative. The following table indicates where evidence was found to substantiate the statements articulated in the working hypothesis framework.

**Table 4-2: Evidence linked to working hypotheses**

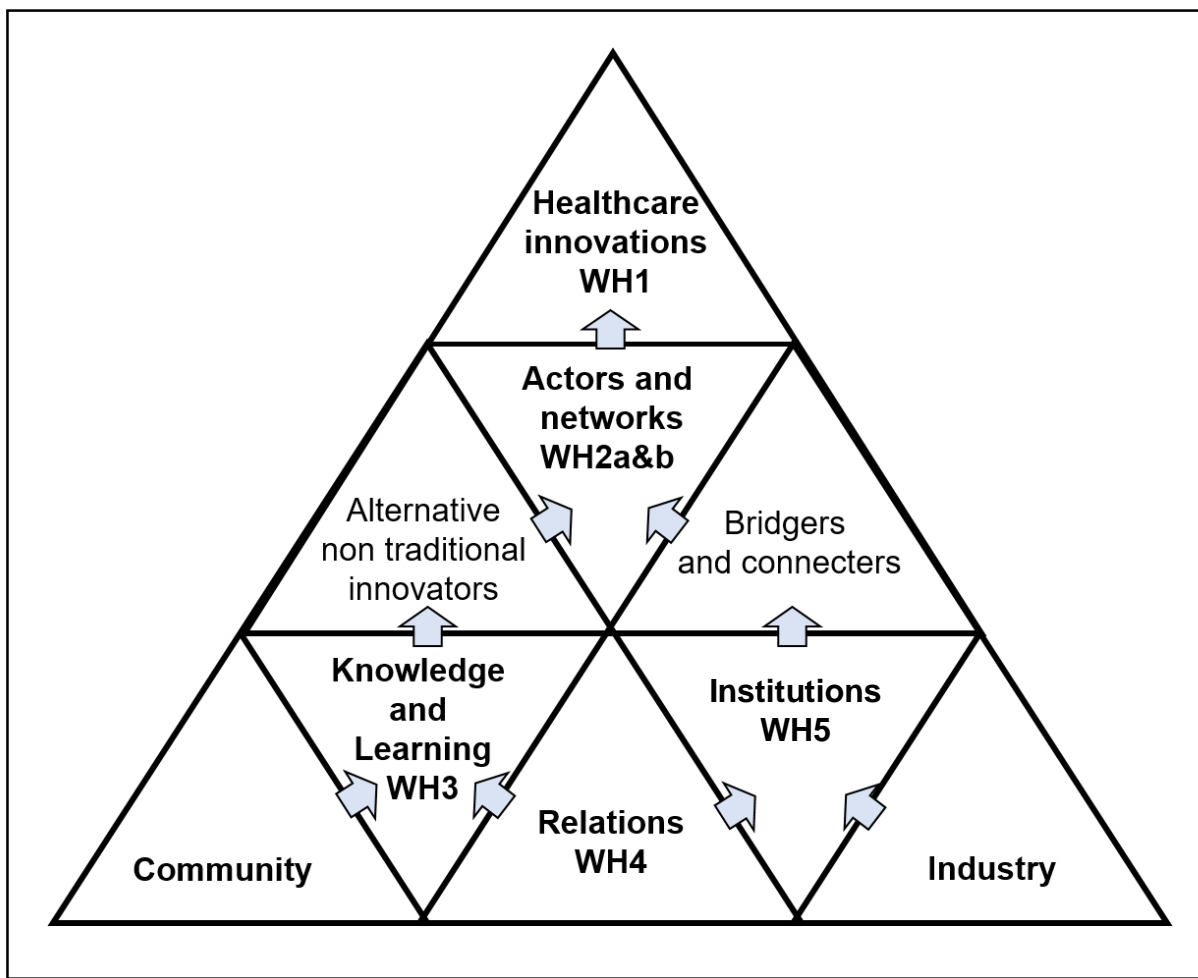
REFERENCE FOR THIS STUDY	DOCUMENT	INNOVATIONS	ACTORS AND NETWORKS		KNOWLEDGE AND LEARNING	RELATIONS	INSTITUTIONS	
		WH 1: Inclusive mHealth innovation systems negotiate consumer wants and supply-side needs with regards to healthcare.	WH 2a: Alternative non-traditional innovators are included.	WH 2b: Bridgers and connectors are incorporated early on in the innovation process.	WH 3: Purposefully structured domain-relevant learning is planned and operationalised.	WH 4: Structured as well as informal relations are accommodated.	WH 5a: Structures are developed to facilitate relations that are, on the one side organic and flexible and, on the other formal and contracted.	WH 5b: Those responsible for operationalising inclusive innovation initiatives are able to feed into strategy formulation.
Doc1	Presentation to stakeholder	✓	✓				✓	✓
Doc 2	Presentation to stakeholder				✓	✓		
Doc 3	DreamGirls Hackathon report	✓	✓	✓	✓			
Doc 4	Codex Hackathon Report			✓				
Doc 5	Flyer	✓	✓	✓	✓	✓	✓	
Doc 6	One 2017 project report			✓	✓			✓
Doc 7	Published Conference paper	✓	✓		✓	✓	✓	✓
Doc 8	Published Conference paper	✓	✓	✓				
Doc 9	One monitoring and evaluation report;	✓	✓	✓	✓	✓		✓
Doc 10	An interim project report from the <i>reHealthAfrica</i> team; and	✓	✓		✓	✓	✓	✓
Doc 11	Book chapter. Chapter 8: mHealth & Wellness Innovation Ecosystem; in “Strategies, approaches and experiences towards building a SA building health innovation”.	✓	✓	✓	✓	✓	✓	✓

The following table summarises the findings of the case study and presents the supported inclusive mHealth innovation framework for South Africa.

**Table 4-3: Inclusive mHealth innovation framework for South Africa**

COMPONENT OF INNOVATION SYSTEM	WORKING HYPOTHESIS (WH)	OUTCOME OF LITERATURE	IMPLICATIONS FOR mHEALTH INNOVATION IN SOUTH AFRICA	POLICY IMPLICATIONS FOR HEALTHCARE INNOVATION
Innovations	<i>WH 1: Inclusive mHealth innovation systems negotiate consumer wants and supply-side needs with regards to healthcare.</i>	Supported	<ul style="list-style-type: none"> <li>• Include consumers/end users in the design of new applications</li> <li>• Need systems to engage with civil society/communities to determine their needs and expectations for mHealth</li> </ul>	Create enabling environment to ensure engagement with consumers/end users as well as civil society on a fair basis
Actors and networks	<p><i>WH 2a: Alternative non-traditional innovators are included.</i></p> <p><i>WH2b: Bridgers and connectors are incorporated early on in the innovation process</i></p>	Supported	<ul style="list-style-type: none"> <li>• Create awareness of the abilities and need for non-traditional innovators.</li> <li>• Create incentives to ensure that bridgers and connectors are involved in the innovation process</li> </ul>	<ul style="list-style-type: none"> <li>• Develop incentives that will enable inclusion on non-traditional innovators.</li> <li>• Develop opportunities and funding mechanisms that will ensure inclusion of non-traditional innovators, as well as bridgers and connectors</li> </ul>
Knowledge and learning	<i>WH 3: Purposefully structured domain-relevant learning is planned and operationalised.</i>	Supported	<ul style="list-style-type: none"> <li>• Need to develop structured opportunities to engage with and enable non-traditional innovators in the mHealth development process</li> <li>• Training opportunities needed</li> </ul>	Create and fund structured opportunities during which innovators, industry, government and researchers can meet with consumers/end users.
Relations	<i>WH 4: Structured as well as informal relations are accommodated.</i>	Supported	Essential that the engagements are fair and enabling	Need to develop rules for fair engagement
Institutions	<i>WH 5a: Structures are developed to facilitate relations that are, on the one side organic and flexible</i>	Supported	Need to develop mechanisms to enable interaction between industry, Higher Education Institutes/Research Institutes, Government and civil society	<ul style="list-style-type: none"> <li>• Facilitate implementation and understanding of IP regulations</li> <li>• Provide access to assist with contracting for non-traditional innovators</li> </ul>

COMPONENT OF INNOVATION SYSTEM	WORKING HYPOTHESIS (WH)	OUTCOME OF LITERATURE	IMPLICATIONS FOR mHEALTH INNOVATION IN SOUTH AFRICA	POLICY IMPLICATIONS FOR HEALTHCARE INNOVATION
	<p><i>and, on the other, formal and contracted.</i></p> <p><i>WH 5b: Those responsible for operationalising inclusive innovation initiatives are able to feed into strategy formulation.</i></p>		<p>/communities to discuss needs for new mHealth applications, such as regular Innovation Forums</p>	



**Figure 4-2: Conceptual framework for inclusive mHealth innovation in South Africa**

The graphical representation of the framework for inclusive mHealth innovation in South Africa (Figure 4-2) provides a high-level interconnection of the supported working hypotheses as building blocks and the refined framework for inclusive mHealth innovation in South Africa as research output. The outcome of inclusive innovation is predicated on the community and industry collaboration and co-creation. Both the industry and community needs are navigated. Relations are facilitated and negotiated through various knowledge exchanges, formal and non-formal relations, and institutions that would accommodate and facilitate the evolution from separate entities to co-creators with shared benefits. As a result, alternative and non-traditional innovators have opportunities to enter as actors into new and existing networks. On the other hand, bridgers and connectors link and facilitate the establishment of new and existing relationships towards forming an ecosystem that is both learning and sustainable. The resulting innovation within the context of the domain is the result of many interactions towards strengthening the National System of Innovation as a whole and complex ecosystem in and of themselves.

Accordingly, the findings provide evidence that the *reHealthAfrica* initiative supports aspects of the components of an innovation system that was adapted for healthcare and extends the concept of innovation ecosystems to inclusive mHealth innovation.

# CHAPTER 5: SYNTHESIS OF FINDINGS, DISCUSSION, CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

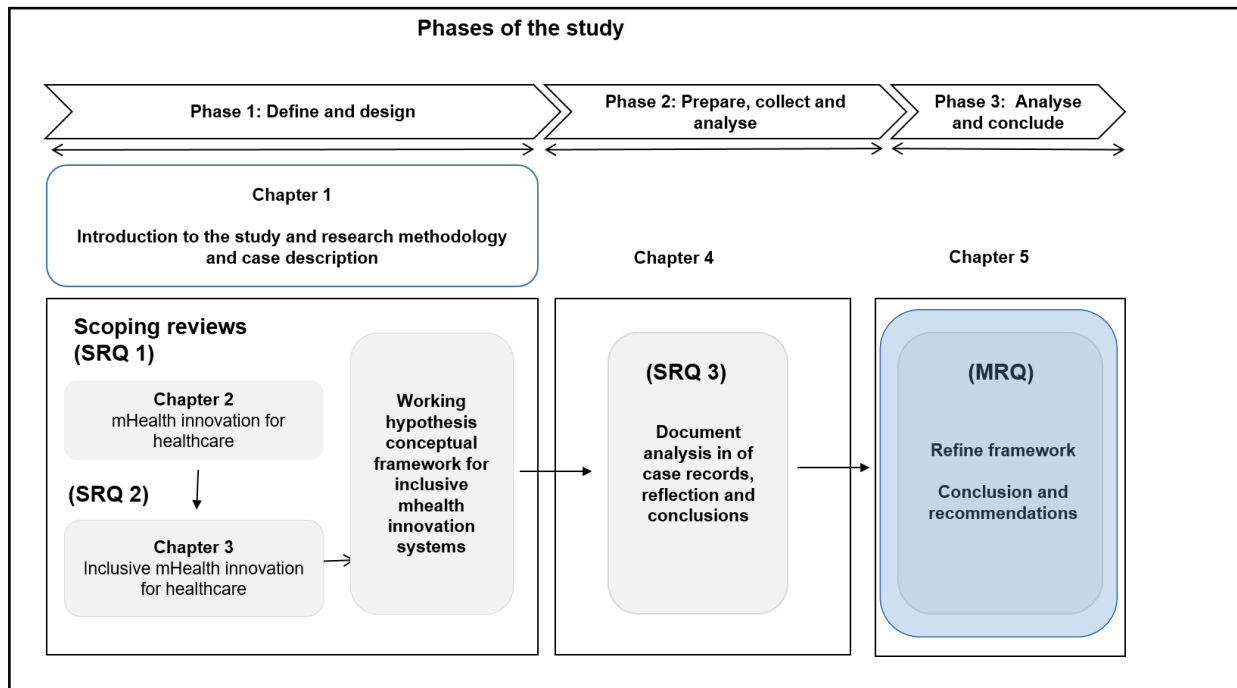


Figure 5-1: Phases to the study relevant to Chapter 5

## 5.1 INTRODUCTION

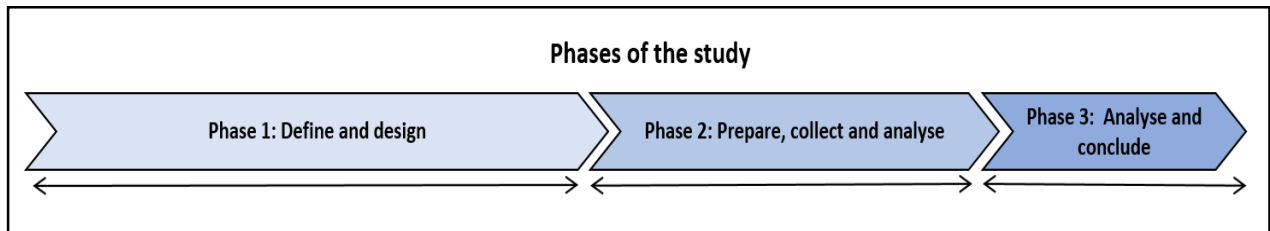
This final chapter reflects on-, and offers concluding considerations based on the investigation, its formulation, the research objectives and the findings that were identified. This chapter summarises key findings and makes recommendations for an inclusive mHealth innovation framework for South Africa. This is aligned with the aim of this research to *identify* and *describe* the components of a framework for inclusive mHealth innovation in South Africa.

The three objectives of the study, as presented in Chapter 1 section 1.3.2, were:

- To explore and describe components that constitute mHealth innovation from literature towards:
  - conceptualising mHealth and mHealth innovation; and to
  - identify the components of mHealth innovation through a description of the requirements, barriers and challenges;

- To describe what inclusive innovation in mHealth entails from literature and derive a generic set of components; and
- To refine the generic set of components for Inclusive mHealth innovation for the South African context through a document analysis of *reHealthAfrica* as an instantiation.

The development of the framework was undertaken as a single interpretive case study conducted over three phases, namely Phase 1: Define and design; Phase 2: Prepare, collect and analyse; and Phase 3: Analyse and conclude.



**Figure 5-2: Phases of this study (Yin, 2009)**

## 5.2 RESEARCH OVERVIEW

The research problem was informed by academic literature on mHealth innovation systems and the notion of inclusive innovation. The healthcare focus was incorporated through specific scoping review searches. As evidence of *broad scale inclusion* and *innovation* of mHealth solutions within the healthcare sector in South Africa is sporadic, this study focused on the *reHealthAfrica* initiative that endeavoured to create a platform for inclusive mHealth innovation development within the health domain in South Africa. Based on this understanding, the problem statement and rationale for the study, the main research question for the study was formulated as: *What are the components that constitute a framework for inclusive mHealth innovation in South Africa?* (Section 1.3.1).

The following sub-research questions were defined to support the investigation of the main research question (Section 1.3.1):

- *What constitute mHealth innovation systems? (Chapter 2)*
- *What does inclusive innovation in mHealth entail? (Chapter 3)*
- *How can inclusive innovation in mHealth be realised in South Africa? (Chapter 4)*

The scoping reviews were grounded in the understandings narrated on Innovation Systems by Bergek et al. (2008) and Hekkert et al. (2007) as summarised by Van der Merwe (2018). These sources contended that there are two different approaches in literature to describe innovation systems: 1) a component-based approach and 2) a function-based approach. This study adopted the component-based or structural approach. Research involved the

identification of system components (the actors, institutions and organisations within the system) and a description of the relations between the components (Hekkert & Negro, 2011).

These components were viewed from an mHealth innovation system perspective as well as an inclusive innovation system perspective to derive a *working hypotheses conceptual framework* (Section 3.4) as described and proposed by Shields and Tajalli (2006). The working hypothesis conceptual framework evolved through two iterations from literature presented in Chapters 2 and 3. It was then further refined and contextualised in Chapter 4 through a case study of the *reHealthAfrica* initiative. The seven working hypotheses were all supported through the document analysis and outlined the conceptualisation of a *Framework for inclusive mHealth innovation for South Africa* (Section 4.7).

The following section links the research questions to the narration of this study.

### 5.3 DISSERTATION QUESTIONS ANSWERED

The subject of this dissertation is to identify and describe the components that constitute a framework for inclusive mHealth innovation in South Africa (MRQ). An investigation to address each sub-research question underpinned the quest towards the main research question. The investigation served as discrete building blocks towards the presentation of the framework for inclusive mHealth innovation in South Africa.

#### 5.3.1 First and second sub-research questions answered

Information on addressing the first and second sub-research questions is presented in Table 5-1. The literature review chapters contribute to a systematic construction of the notion of inclusive innovation in mHealth in South Africa.

**Table 5-1: Sub-research question one and two answered**

TOPIC	DESCRIPTION
Sub-research questions 1 and 2:	SRQ 1: What components constitute an mHealth innovation system? SRQ 2: What do inclusive innovation systems in mHealth entail?
Addressed in:	Chapters 2 and 3
Main findings (outputs):	Addressing SRQ 1: The methodology chapter (Chapter 1) provides a notional description of the interim working hypothesis conceptual framework; the single case study applied and outlines the reHealth initiative as the case. Chapter 2 presents a scoping literature review on mHealth innovation systems and, highlight the <i>components of an innovation systems</i> . The outcome of the exploration is presented in Table 2-5 as elements of the mHealth Innovation system.  Addressing SRQ 2: The literature in Chapter 3 explores inclusive innovation systems and concludes by presenting inclusive innovation

	system elements as framed by the components of an innovation system in Table 3-6.
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### 5.3.2 Third sub-research question answered

Table 5-2 presents the enquiry into the third sub-research question, as reported in Chapter 4.

**Table 5-2: Sub-research question 3 answered**

TOPIC	DESCRIPTION
Sub-research question 3:	SRQ 3: How can inclusive innovation in mHealth be realised in South Africa?
Addressed in:	Chapter 4
Main findings (outputs):	<p>The realisation of inclusive innovation in mHealth in South Africa is addressed in Chapter 4 through an interpretive single case study of the <i>reHealth initiative</i> using document analysis and framed by the working hypothesis conceptual framework presented in Table 3-7. Chapter 4 presents a descriptive narrative on the components of an innovation system. The 5 components were substantiated through the scoping literature review in Chapter 2 and 3 and presented as a working hypothesis conceptual framework in Table 3-7.</p> <p>Each of these working hypotheses were critically reviewed from evidence collected and scrutinised through a document analysis. Consequently it is argued that there is sufficient evidence presented from multiple documents to claim that the hypotheses are supported. As the working hypotheses present provisional statements, the evidence collected additionally provided insights into the nature of the phenomena encapsulated in the hypotheses. These insights provide a richer description towards answering the main research question.</p>

### 5.3.3 Main research question answered

Conclusions drawn from the scoping literature reviews and the case (Chapter 4) to answer the first three sub-research questions, informed, and were used, as building blocks towards answering the main research question. The refined framework for inclusive mHealth innovation in South Africa (section 4.7) is presented and refers back to findings within the chapter.

**Table 5-3: Main research question answered**

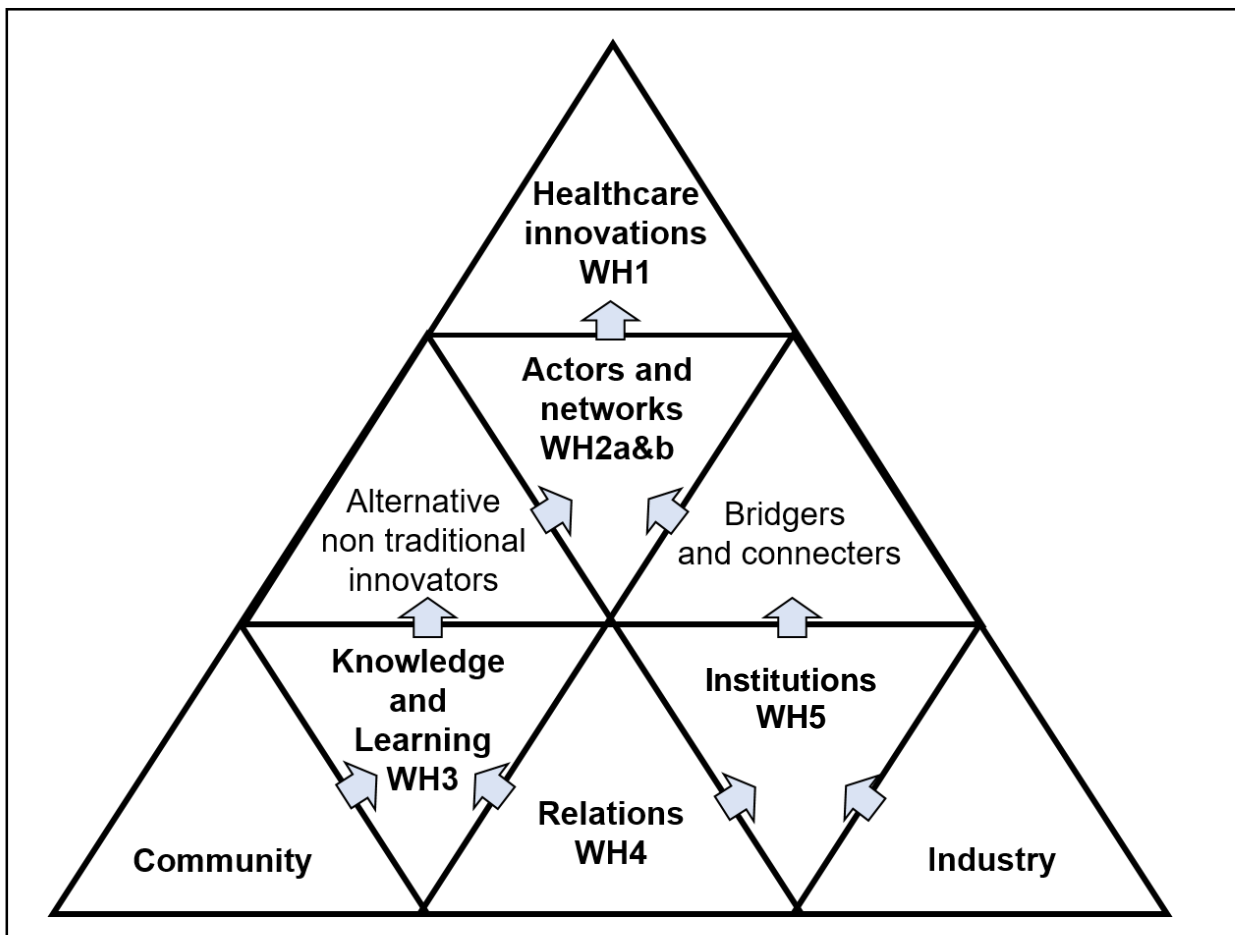
TOPIC	DESCRIPTION
Main question:	The identification and description of the components of a framework for inclusive mHealth innovation in South Africa.
Addressed in:	Chapters 4 and 5
Main findings (outputs):	The identified components of an innovation system were linked to mobile innovation system and inclusive innovation system elements through scoping literature reviews (Table 2-3 & Table 3-6). A derived working hypothesis conceptual framework informed the interpretive single case

TOPIC	DESCRIPTION
	<p>study realised through a document analysis. All the working hypotheses were supported by evidence found in the document analysis.</p> <p>The components were further described from additional insights gained through the document analysis. The refined framework for inclusive mHealth innovation in South Africa is presented in section 4-7 with references to relevant findings in Chapter 4.</p> <p>The key findings are reiterated in this section.</p> <p>The framework was developed by applying a single case study method, concluded over three phases.</p>

**Table 5-4: Inclusive mHealth innovation framework for South Africa**

COMPONENT OF INNOVATION SYSTEM	WORKING HYPOTHESIS (WH)	OUTCOME OF CASE STUDY	DISCUSSION
Innovations	<i>WH 1: Inclusive innovation systems for mHealth negotiate consumer wants and supply-side needs with regards to healthcare.</i>	Supported	Section 4.2
Actors and networks	<p><i>WH 2a: Alternative non-traditional innovators are included.</i></p> <p><i>WH2b: Bridgers and connectors are incorporated early on in the innovation process.</i></p>	Supported	Section 4:3
Knowledge and learning	<i>WH 3: Purposefully structured domain relevant learning is planned and operationalised.</i>	Supported	Section 4.4
Relations	<i>WH 4: Structured as well as informal relations are accommodated.</i>	Supported	Section 4.5
Institutions	<p><i>WH 5a: Structures are developed to facilitate relations that are, on the one side organic and flexible, and on the other formal and contracted.</i></p> <p><i>WH 5b: Those responsible for operationalising inclusive innovation initiatives are able to feed into strategy formulation.</i></p>	Supported	Section 4.6

Figure 4-4 graphically depicts and Sections 4-15 describes the inclusive mHealth innovation framework for South Africa as outcome of the *reHealthAfrica* case study.



**Figure 5-1: Inclusive mHealth innovation framework for South Africa**

The following section provides information on the research design followed in conducting the research.

#### **5.4 SUMMARY OF THE RESEARCH DESIGN**

The single case study outline, as suggested by Yin (2009), operationalised through working hypotheses (Shields & Tajalli, 2006) and guided by the component-based description of an innovation system as outlined by Wieczorek and Hekkert (2012) framed the research process of the study. Figure 1-2 illustrates the research process of the study, which is also extensively explicated in Chapter 1 (section 1.6). Figure 1-4 situates the chapters within the research process of the study. The phases of the research process are briefly described as follows:

**Phase 1:** The study was introduced, and the background to the study, problem statement, purpose and research questions were presented. Phase 1 is documented in Chapters 1, 2, and 3. This Phase focused on investigating the literature to examine and identify the components of an innovation system. These were linked to the literature-identified elements of an inclusive mHealth innovation system and articulated as working hypotheses.

**Phase 2:** This phase is outlined in Chapter 4. The case study and document analysis of the *reHealthAfrica* case study were part of this phase as outlined in Chapter 4. The findings supported the working hypotheses and added further nuances to the description of the components.

**Phase 3:** Phase 3 outlines the articulation and visualisation of the revised framework for inclusive mHealth innovation in South Africa. As presented in the latter part of Chapter 4 and summarised in this concluding chapter, Chapter 5.

The next section presents a reflection on knowledge contribution of this study.

## **5.5 CONTRIBUTION TO KNOWLEDGE**

The study findings contribute to the discourse in innovation system research and the health informatics domain. The study presents the articulation of a framework that can be considered when embarking on an inclusive innovation initiative in mHealth. Additionally, it can inform similar endeavours to include youth, higher education and innovation agencies towards a more inclusive approach.

The following section presents the delineation and assumptions of the study.

## **5.6 LIMITATIONS OF THE STUDY**

The study narrates the findings of a case study that included a single mHealth inclusive innovation initiative that led to the establishment of *reHealthAfrica* as a broader outreach. As a reflective endeavour, supported descriptive findings from a component-based view are presented. The generalisability of this study can be improved by applying and evaluating the findings in additional settings and domains.

The next section provides scientific, methodological and personal reflections on the study.

## **5.7 REFLECTIONS ON THE STUDY**

The following sections present scientific, methodological and personal reflections with regard to the study.

### **5.7.1 Scientific reflection**

The study is about the development of a framework for inclusive mHealth innovation in South Africa. It is underpinned by an interpretive research philosophy.

The process model of the study was informed by the activities described by Yin (2013). Although Yin is considered a positivist, the study adheres only to the process he describes and not to the underlying philosophy. It can be argued that some of the positivist agenda does seep through in the use of working hypotheses and the conceptual framework that guides the further inquiry. However, using working hypotheses as statements of intent is viewed as being guided by interpretivist notions. The scoping literature reviews of mHealth innovation systems and inclusive innovation systems could be seen as limiting; however, in the context of this study, they were used as a tool to focus the area of investigation to the scope of a Masters study. The information presented in this section provides evidence that the study was based on, and was characterised by the methods and principles of science. The following section provides a methodological reflection.

### **5.7.2 Methodological reflection**

The following questions are answered as a way to reflect on the methodology used during the execution of the study.

*Was the chosen research methodology the best option for answering the research questions?*

The study was concerned with the design and development of a framework for inclusive mHealth innovation in South Africa. The methods, procedures and guidelines incorporated in the single case study methodology were utilised for the execution of this study. Orlikowski and Baroudi (1991) state that “interpretive studies assume that people create and associate their own subjective and intersubjective meanings as they interact with the world around them. Interpretive researchers thus attempt to understand phenomena through accessing the meanings participants assign to them.” This study claims to have utilised known and accepted interpretive methods of research. The study was initiated from what is already known (through literature studies) and touches on the domain of human action, and social construction by human actors through a document analysis that describes the subjective reality as experienced (Walsham, 1993). Conclusions and claims around the generalisability of these conclusions are then subject to the contextual and human factors that influence it.

## **5.8 PERSONAL REFLECTION**

Engagement with the subject matter and conceptualisation of the inclusive mHealth innovation resulted in the concretisation of the concepts in my official work, as Director for Health Innovation at the Department of Science and Technology (DST). It also assisted me to put a number of mechanisms in place to ensure inclusivity within the health innovation projects that are currently funded through the DST.

## **5.9 THE WAY FORWARD**

The lessons drawn from this dissertation could be useful for select decision makers in the South African innovation domain and other similar environments. It could also be useful to support inclusivity when working with innovation in side-lined sectors of a specific domain. The framework, therefore, has the potential to provide relevant input into further descriptive and predictive studies in the innovation domain in South Africa. Countries with similar social and economic conditions can cautiously adapt the findings within the context of their own innovation practices.

### **5.9.1 Areas for future academic and practical research**

The following research topics could be investigated in future to broaden the collective understanding of this specific knowledge domain:

- Establishing the effectiveness of the inclusive innovation activities by exploring how it can support and benefit other domain innovations in practice in similar contexts in other developing countries.
- Guidelines for the implementation of the proposed and final framework.
- A continuation of the *reHealthAfrica* initiative impacts on healthcare and innovation in and around health and wellness.

The following section presents concluding remarks about the study.

## **5.10 SUMMARY**

The intention of this study was, firstly, to identify and describe components for inclusive mHealth innovation in South Africa. Through the case study and document analysis various findings are presented that add nuances to the description and can enhance similar activities to provide an opportunity for all to participate in mHealth initiatives towards a healthier South Africa.

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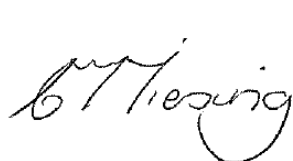
**ADDENDUM A: LETTER FROM SCIENTIFIC COMMITTEE  
CONFIRMING THAT NO ETHICS PERMISSION TO BE REQUESTED**



Scientific Approval by the Scientific  
Committee Research Using  
Human Participants

Scientific Committee Information			
<b>Name of the scientific committee</b>	AUTHeR Scientific Committee	<b>Discipline(s)</b>	Transdisciplinary Health Science
<b>Research entity</b>	AUTHeR	<b>Contact person for the committee</b>	Prof Lanthé Kruger
<b>Faculty</b>	Health Sciences	<b>E-mail of the contact person for the committee</b>	AUTHER-SciCom@nwu.ac.za
<b>Title of the study:</b>	<b>Towards an inclusive mHealth innovation framework for South Africa: A case study</b>		
<b>Researchers involved in the study:</b>	Prof Adele Botha Prof Petra Bester Prof Lanthé Kruger		
<b>Executive summary (150 words) of the research:</b>	<p><b>Towards an inclusive mHealth innovation framework for South Africa: A case study</b></p> <p>mHealth holds the potential to enhance healthcare equity and access especially in developing countries. Despite a major uptake in mobile device uses, mHealth remains fragmented. Inclusive mHealth innovations could fill this gap as it aims to not only stimulate the National System of Innovation but also unlock the mHealth development domain that is currently dominated by a selected few large innovation houses. This study aims to <i>identify</i> and <i>describe</i> the components for an inclusive mHealth innovation framework for South Africa through a single, holistic case study of the <i>reHealthAfrica</i> innovation initiative. Two scoping literature reviews will be conducted. Firstly to explore and describe the components that constitute mHealth innovation in order to conceptualise mHealth and mHealth innovation. The second scoping review will explore the concept of inclusive mHealth innovation. Thereafter follows a document analysis of 45 documents available within the public domain, freely accessible via the Internet; to be obtained through an all-inclusive sample. Document analysis will be conducted according to a data sheet presenting the components of an innovation system. The results from the scoping reviews and the analysed documents will lead to the formulation of working hypotheses to propose a conceptual framework for inclusive mHealth Innovation.</p>		
	No risk	<input type="checkbox"/>	

<b>Potential risk level for human participants:</b>	Minimal risk	<input checked="" type="checkbox"/>	Motivate: This study will make use of literature reviews to identify and describe the components for an inclusive mHealth innovation framework for South Africa. All the literature is freely available in the public domain, accessible through Google
	Medium risk	<input type="checkbox"/>	
	High risk	<input type="checkbox"/>	
<b>Potential risk level for children and incapacitated adults:</b>	No risk	<input type="checkbox"/>	Motivate: Click here to enter text.
	No more than minimal risk of harm	<input type="checkbox"/>	
	Greater than minimal risk with the prospect of direct benefit	<input type="checkbox"/>	
	Greater than minimal risk with no direct benefit	<input type="checkbox"/>	
<b>Recommendation for the REC:</b>	Review by research ethics committee	<input type="checkbox"/>	Motivate: This study will only entail literature reviews. No participants will be included into the study.
	Exempted from review by the research ethics committee	<input checked="" type="checkbox"/>	
<b>Any additional comments</b>	Motivate: This is a desktop study, utilising only literature. No participant engagement, permission of informed consent are required.		
<b>Chairperson of the scientific committee</b>	Prof Lanthé Kruger		
<b>Scientific committee members present during the review</b>  (NB, please ensure no conflict of interest)	Prof Lanthé Kruger Dr Nicole Claassen Dr Christi Niesing Dr Anselm Berde		
<b>Date of review</b>	2019/05/02		




\_\_\_\_\_  
Signature of Chairperson

Date: 2019/06/18

\_\_\_\_\_  
Signature of Research Director

Date: 2019/06/18

## ADDENDUM B: DIGITAL TURNITIN RECEIPT

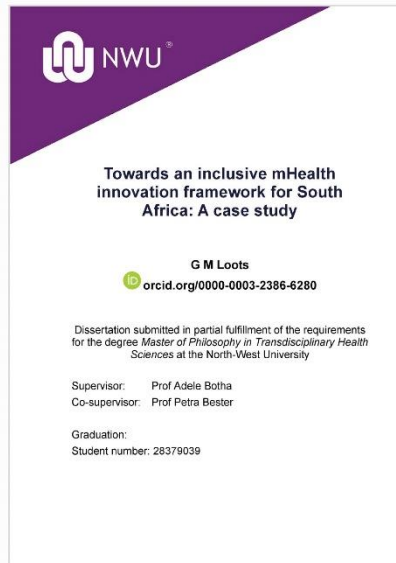


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# ADDENDUM C: CERTIFICATE FROM LANGUAGE EDITOR



## EDITING DECLARATION

This document certifies that the dissertation listed below was edited for proper use of English language, grammar, punctuation, spelling, and overall style. The same dissertation was edited for the correct use of Harvard referencing style according to the requirements of the North-West University.

Neither the research content nor the student's intentions were altered in any way during the editing process. The student was given the ability to accept or reject all suggestions and changes. The student is responsible for the final, correct presentation of the content, illustrative materials, tables, arrangement of parts, sentence structure, grammar, paragraphing, punctuation, spelling, typographical errors, quotations, bibliographical items, and all information contained within.

### Title

Towards an inclusive mHealth innovation framework for South Africa: A case study

### Author

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### Date Edited

24 June 2019

### Editor

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Baccalaureus in Business Communication, 2000 (North-West University)

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